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INVESTMENT BUILDING **WASHINGTON, D. C.**

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*
J. D. ROMAINE, *Chief Agronomist*
Editorial Office: Investment Bldg., Washington, D. C.

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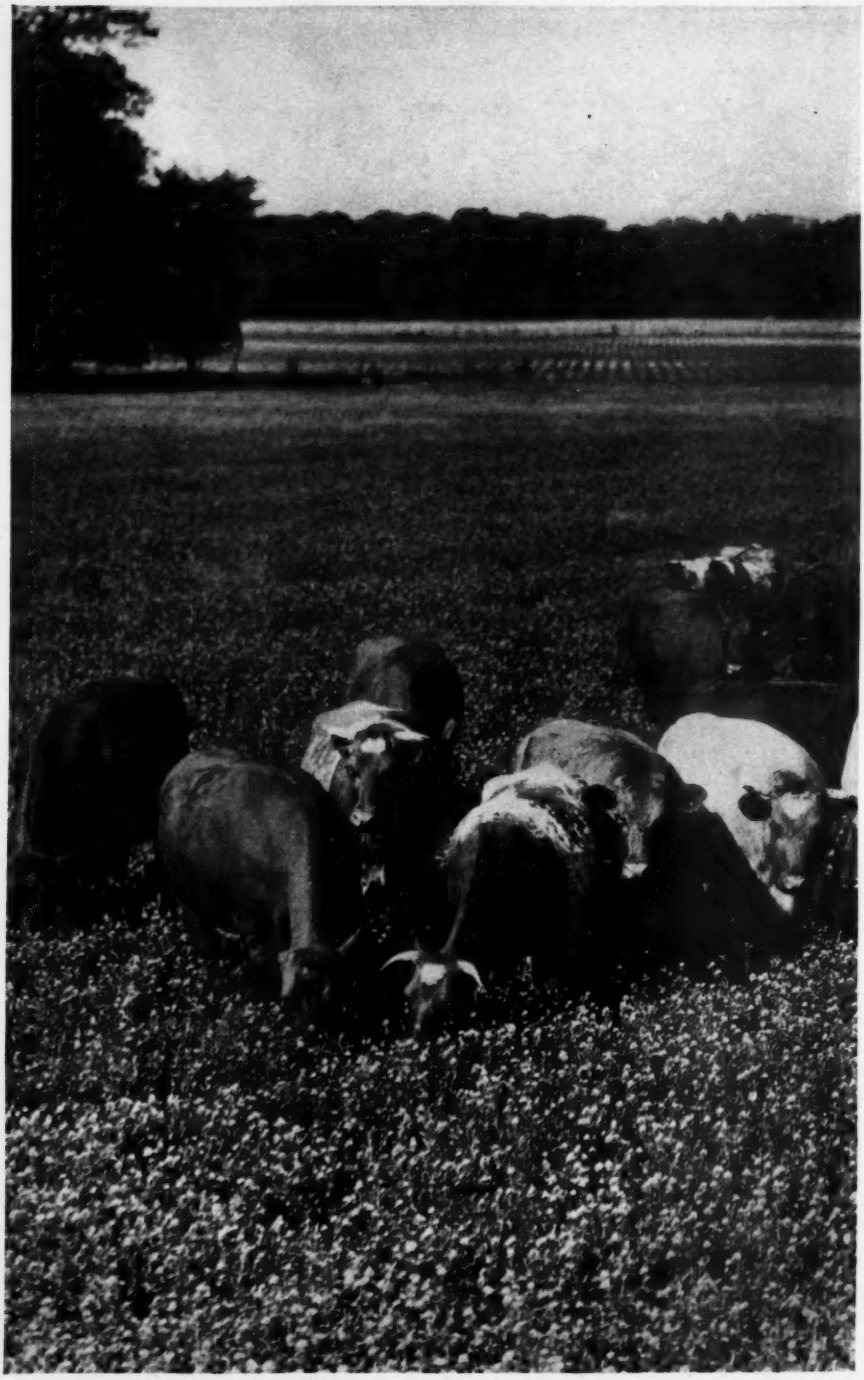

KNEE-DEEP IN CLOVER—A BOVINE'S PARADISE.

Better Crops with PLANT FOOD

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Let Americans give—

The Soil Salute

Jeff McDermid

AS I have observed on many a previous Fourth of July, real patriotism takes perspiration, and it pays to hustle before you hurrah. Back of all our zeal and hysteria for military and naval defenses, back of our alertness to safeguard the democratic way of life, back of our loyalty to the flag and its traditions—clear back of that nearly a third of our population stands at attention to salute the soil. And the other two thirds would soon know why, if this nation were caught in the maelstrom of war.

For all the tank battalions and sky-soaring gunners, all the powder makers and cannon shooters depend upon a strong secondary "larder line" to provide the vitamins of victory. But we need to take a calmer view of the situation, because actual armed defense is something of a conjecture thus far, while the more pressing need is for internal vigilance and coordinated efforts at conservation.

I think we can dismiss for the moment all gory visions of young farmers leaving the tractor for the tank; and postpone our worries over how long it might take for the irritating "surplus" to become a deathly deficit in case of invasion.

It is a time for us who love the land to remember that Land's End in Cornwall has a unique symbolic significance for our own dilemma. We too have often pondered about the "land's end" in America and what it means to mankind. Just as that barren English coast suddenly vanishes into a turbulent sea,

its foggy skies flickering with warning flares, so we in America must not exert all our might and preparedness in violent destructive combativeness. Conservation of "soil, rain, and man," as the Friends of the Land declare, must not be sidetracked in any defensive program.

I believe we should have as strong and as thoroughly technical and as widely representative a national alliance for the soil's sake as we have set up to manufacture munitions to blast caverns in the earth. Possibly before this humble screed gets to our readers (while July Fourth orators are booming about bombing), Chester Davis of the president's defense board may have issued a call for a new and vital organization cut crosswise through our national life in defense of the land and the larder. Knowing how keen he is to get done things that are worth doing well, I suspect this doctrine will be part of our program soon. There is plenty of scrap left in Chester, even though he has been cloistered in a "bank vault" awhile.

MY IDEA is that we can do plenty to improve our domestic agricultural conditions, from erosion control and flood and soil programs to human salvage above ground—which is even more significant. The war abroad will surely do something drastic to our farm exports and perhaps put us on a sort of military economy sooner or later. Hence we need to get our beleaguered columns of soil soldiers on a war footing, just as much as we need to build airplanes and redefine our industrial defenses from sky attack. We must do this in a voluntary, well-seasoned, popularly governed way, or else soon begin direct imitation of Fascist methods, if other means fail us.

No doubt this is a time to forget petty farm organization squabbles and rivalry, to handle local agricultural policies with a decent regard for human rights, to forego erstwhile alignments, political, racial, or religious. No doubt the Enemies of Democracy bank on their belief that our ingrained, free-will individualism in America will get us into more difficulty than all their fifth columns could. (And, by the way, I often think *some* of our own columnists are doing us almost as much harm by maudlin yelping.)

When I ask myself what does this defense of America mean and why do we love the land, I almost come to feel that the crisis may be a friend in disguise. Before you report me for saying this, let me explain. I mean that we have taken a precious lot of our sentiment for granted, without really knowing why we feel sentimental about this great open country of ours, so vast and varied.

WE have read musty histories and listened to vainglory on the stump. We have thought that liberty meant "100 per cent Americanism," which in turn signified that anybody who suggested making improvements was a traitor. Stand-pat-ism is related to defeatism, because it ignores our weak spots and throws us into the jitters when they are finally exposed to the enemy. We must be willing to take risks on new ground or else stagnate and perish in a slough of inertia. We simply cannot adopt a coat of armored mail and imagine we are safe therein from the cancer or the ulcer inside us. Let's not forget to look forward.

So I reckon we need to redefine what we mean by liberty and freedom over here, lest by mistaking it for popular mob psychology we rush into a lopsided stampede, misled and bedeviled as badly as some of the farm folk of Europe, who would rather be harvesting turnips than digging graves. We ought to know, moreover, how much of this era of hysteria is home doctrine and how much is skillful propaganda cooked up and served hot for 1940.

Just imagine how far we might go in land reclamation and conservation, if we had the ability to frighten folks into land defenses to the same extent that this country has been swept off its feet lately by the blitzkrieg stories. But

when you get newspaper reports about the steady gnawing advance of General Erosion, with mightier claws than aerial bombs, or when you read of the deadly, coppery rays of General Drouth, everybody yawns and says it's just another fool scheme to regiment the farmers.

PERSONALLY, I feel so much in debt to democracy and its benefits and traditions that I never hope, at my age, to get square again. It is probably too late for me to pay back any of the installments by enlisting in the army. I am afraid that would be like settling up with bogus checks. There must be another way.

When I was very young and throughout the formative period of my teens, our home and school echoed to the dual fervency of religious precept and patriotic themes. We listened to these in varied versions and by voice and musical appeal. I cannot recall it as hypocritical or stilted either, testing it carefully now in the mellowness of retrospect. Your own early experiences probably match mine in this regard, you who were youngsters in the early nineties.

It was a sort of primitive nobility and honesty of expression, natural enough because of the simplicity of our daily lives and the limited scope of our private ambitions for power or wealth. We just "lived" and enjoyed living together, always with the background of a hard-won country. Our parents looked back only a couple of generations to relatives who endured the revolution and the war of 1812. All those elders got out of it was the precious shibboleth of "liberty and equality," and only a very few of them obtained any government solace or financial reward. The only "security" they wanted was a chance to make a decent living. They did not cuss much about conditions either, because nobody expected to be paid for doing a little extra sharpshooting with the family musket.

Preparedness in those days consisted of cleaning the gun and filling the powder horn, and barefoot Colonials did not need many supplies to ambush an enemy lost in the woods. Wars were so much like bear hunting or "feuding" that the boys took a chance eagerly for the sake of being left alone afterwards to plow in peace amid the stumps.

But they were mighty chesty about their leaders in buckskin who craftily piloted them through the wilderness. Legends about the things that Robert Rogers or Ethan Allen or Israel Putnam had to say on certain historic occasions were repeated around the open fireplaces from 1820 down to the day of our birth, gaining much potency in the reviewing thereof.

HERE was a lusty crew of rural workers who came over here to escape the old country's military bondage, themselves eager to go gunning again so they could plant in peace eventually. They may have had their eyes on continental conquest collectively, but hardly individually. There were no wholesale exploiters in a military way among them, except perhaps Aaron Burr.

What then animated those struggling stragglers of pioneer America when they fought and bled for liberty? Surely it was not material vanities. The crops they had were nothing to brag about, and in fact today they would be used as a check to point out what ought not to be done. Their livestock was little short of a disgrace in terms of progressive breeding. Nobody had laid away any treasures worth risking a scalp to save, not even down in Kentucky where we have buried ours. Life was one long battle against weather vagary, pests, thieves, and unknown germs. Schools, churches, and town halls were at best poor symbols of dignity or destiny. There was hardly a public structure in the whole land in those times which could compare with a new PWA

(*Turn to page* 47)

3 in 1 Fertilization For Orchards

By Dr. F. W. HofMann

Agricultural Experiment Station, Blacksburg, Virginia

IN some soils of Virginia, profitable growing of apple crops may be carried on for 20 to 30 years without the need of any fertilization other than some form of nitrogen. In some instances in this State, profitable fruit growing may be carried on for its entire commercial life without any commercial fertilizer whatever. In many Virginia soils, however, some form of commercial fertilizer applied to apple trees has resulted in profitable responses either directly or indirectly.

Taken as a whole, nitrogenous applications have resulted in the more outstanding growth and yield responses in apple trees, especially in their younger history. Such responses are usually so clear and evident to the average apple grower of Virginia that he is quite convinced of certain advantages from the use of nitrogenous fertilizers. The possible phosphatic and potassic needs are not very clear to the average grower, because responses to such fertilizers are seldom as evident as with the use of nitrogen in some form. Just the same it is well to call attention to definite cases of responses to phosphatic or potassic applications. Before going into such instances, the role that the three essential elements, nitrogen, phosphorus, and potash, play in the apple tree should be understood.

The Role of Nitrogen

The effects of a lack of nitrogen in a soil are very marked with apple trees, especially in its foliage. This is because nitrogen is an important constituent in the production and maintenance of chlorophyl. Without chlorophyl the growth of the tree is correspondingly impeded, resulting in a general checked development. Not only does a sufficient nitrogen content facilitate all the photosynthetic activities, but it gives the apple tree a greater capacity for the intake of soil moisture with its nutrient solutes resulting in greater growth potentialities. Only with a sufficient nitrogen content can the tree utilize these solvents, particularly phosphorus and potash. Nitrogen is present largely in the foliage and younger shoots in the earlier stage of growth, but is rapidly translocated to become a prominent protein constituent with the development of fruit and seed in the apple tree. In the end larger proportions of this element are found in the fruit and seed.

Symptoms of nitrogen depletion in apple trees are generally recognized in the stunted terminal growth with small, hard buds, many of which will fail to develop further, in small stiff yellowish leaves tinged with splotches of reddish purple extending more markedly in the petioles, in a heavier purple pigmentation of the leaf midrib and veins, slender, attenuated stem and twig development, and a retarded root growth with a predominance of yellowish cortex in the newer growth.

Nitrogen is available to apple trees more readily in the form of nitrates, but is also available to a significant degree in the form of soluble ammonium salts. With grass cover crops in orchards it has been found that a unit of nitrogen taken up as a nitrate is very much more effective in promoting earlier, rapid growth than is the same unit of nitrogen in the form of ammonium salts, particularly before the season advances

through May, June, July, and August.

Phosphorus is associated with cell division and certain phases of tissue development in apple trees. In abundance, particularly as a double salt with ammonia, it encourages rapid cell division, bud development, and fruit set. It is extremely valuable to induce fruit bud differentiation. Just how phosphorus reacts in the apple tree is not entirely clear except perhaps as ammonium phosphate.

The Role of Phosphorus

The role of phosphorus or of phosphates in the physiological processes of the cell seems to be difficult to ascertain. The element itself is a constituent of some protein complexes and of the lecinthin-like bodies, which are supposed by some investigators to play an important part in determining the rate of chemical changes which take place in the cell and the movement of materials into and out of it. It is an essential constituent of the nucleus, and a meager supply of phosphorus retards, or inhibits, mitotic cell-division even when the size of the individual cell increases in the presence of an abundance of nitrogen. Photosynthesis of sugars and the condensing of these into starch or cellulose take place in plants in the absence of available phosphorus; but the change of these insoluble carbohydrates back again into soluble and available sugar foods does not.

Much attention has been devoted to the conditions under which phosphates become available as food for apple trees. Phosphorus is taken from the soil by plants in the form of phosphates. Much study has also been given to the problem of the proper supply of available soil phosphates for economic crop production.

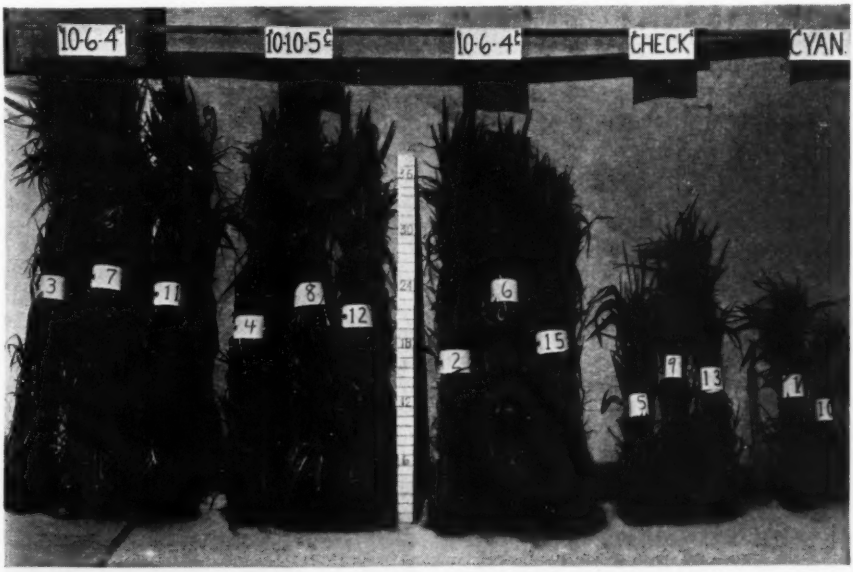


Fig. 1.—Bundles of 30 best-developed rye plants selected at random from plots sown to rye on Nov. 12, 1938, after having been treated the previous month as follows: Plots 3, 7, and 11 with a 10-6-4 fertilizer at the rate of 1,000 lb. per acre with nitrogen source from sodium nitrate, sulphate of ammonia, uramon, and ammonium phoshate; plots 4, 8, and 12 with a 10-10-5 fertilizer at the rate of 1,000 lb. per acre with the source of nitrogen from calcium cyanamide and ammonium phosphate; plots 2, 6, and 15 with a 10-6-4 fertilizer at the rate of 1,000 lb. per acre with calcium cyanamide the only source of nitrogen; plots 5, 9, and 13 check or control with no fertilizer treatment; and plots, 1, 10, and 11 with calcium cyanamide alone at the rate of 475 lb. per acre. All plots except the controls received the equivalent amount of nitrogen. These exposures were made at the time of the first measurements, namely, April 12, 1939. The final total grain and straw harvested June 19, 1939, and thoroughly dried showed the yield significantly in favor of the 10-10-5 fertilizer treatment.

The final result of an ample supply of phosphates particularly in a proper balance with nitrogen and potassium in more precocious fruit bud formation and seed production, as contrasted with that of an over-supply of nitrogen, has led to the popular statement that "phosphates tend to make fruit." This statement, while not strictly accurate, seems to sum up fairly well the end results of the role of phosphorus in the soil nutrition's reactions on apple trees. It is well known that large amounts of phosphorus are stored in the buds and seeds. The two facts that large amounts of these compounds are present in vigorously developing shoots and that relatively large proportions of phosphates are taken from the soil by the apple during the early stages of growth are undoubtedly connected with its possible reaction in inducing more rapid cell-division and as a result the increase of cells especially in meristematic tissue.

Phosphorus deficiency in apple trees shows symptoms as follows: darker green than usual in the leaves, especially when just developing, with a tendency towards mottling in the older foliage; high degree of purplish red pigmentation in both stem and leaves; paper-like texture in leaves and stiff growth development from stem; slender attenuated twigs; retarded bud development; decrease in root hair development; slowing down of cell divisions; a greater degree of dead twig and limb growth in the more shaded parts of unpruned and lightly pruned trees; and a lower phosphorus content in such "die back."

The Role of Potash

The popular expression that "potash makes sugars and starch" is accepted as an accurate description of the role of this element in plant metabolism. The photosynthesis of starch, with the changes necessary to its translocation, stops at once if an insufficient supply is present. The production and storage of sugar or starch in such root crops as beets, potatoes, and fruits diminishes in direct proportion with a decreasing supply of potassium intake. Seeds become shrunken as a result of potassium starvation but are plump and well filled with starch in the endosperm when sufficient potassium is available.

The general tone and vigor of growth of plants are largely dependent upon an ample potassium intake. Potash-deprived parts of fruit trees, like those that have been girdled or weakened by unfavorable conditions, have been found to be more susceptible to injury by disease than those which are amply supplied with this food element.

Fruit trees deprived of potassium show such deficiency by relatively slender twig and stem growth; retarded development of shoot terminals; chlorotic tendency along the veins of leaves; appearance of marginal leaf "scorching," including in severe cases the entire leaf, petiole, and twig; tendency to root and twig "die back"; and tendency of fruit to become subject to a greater

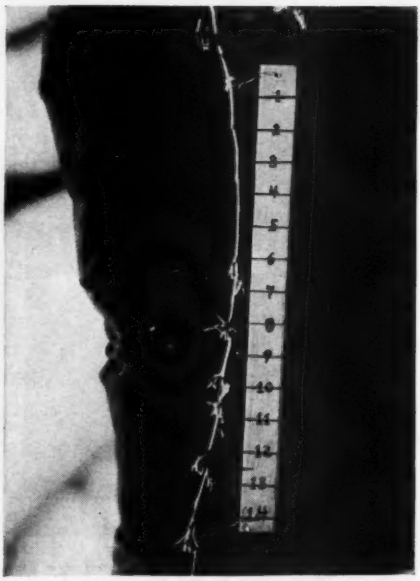


Fig. 2.—Average terminal growth on York apple tree produced during the heavy on-year in the wet season of 1937 treated with a complete fertilizer. The average number of fruits produced on these terminal growths was 11. Some terminal shoots produced as high as 36 fruit buds. This explodes the theory that it is necessary to have one year devoted to spur development before fruit buds can develop.

Fig. 3.—Average York tree with its abundance of strong, vigorous linear shoot growth in its on-year producing some 20 bu. of fruit along with an abundance of fruit buds treated with complete fertilizer during the moist season of 1937.

degree of "spotting" on the tree and in storage.

Plant pathologists and physiologists have recognized the vital importance of a nitrogen, phosphorus, and potash balance in the orchard soil for the past several years. Leaf scorching and dieback in potash-deficient soils were caused to disappear with the application in liberal amounts of potassium salts. With fruit from Grimes Golden plantings deficient in potash supplies because of root crowding and the consequent limitation of the quantity of soil available to the trees, "spotting" was the general rule in cold storage and even before storage. Such was not the case with fruit harvested from trees liberally supplied with potash.

Very recently entomologists report observations that indicate the value of a correct nitrogen, phosphorus, and potash balance as a solution for the Comstock mealybug problem. In his address on December 7, 1939, before the 44th annual meeting of the Virginia Horticultural Society at Roanoke, Virginia, Dr. W. J. Schoene, Entomologist of the Virginia Agricultural Experiment Station, made the following statement: "It has been suggested that the annual applications of nitrate may have stimulated the growth of the tree and increased the consumption of plant food until the available potash has become somewhat depleted, and that this condition has contributed to the mealybug outbreak as well as to the poor color and the delay in ripening of the fruit. Fertilizer experts have found that normal plant growth requires a balance of nitrogen, phosphorus, and potash and that an oversupply of some of the elements results in a depletion of the others." These implications stress the vital need for a correct nitrogen, phosphorus, and potash balance in orchard soils.

There is no known difference in the availability or effectiveness of potassium from the different forms of compounds containing it which may be present in the soil. Some of these phases will be suggested later in a discussion of interactions between fertilizers. Apparently, the principal essential is that the compound shall be soluble so that it can be absorbed into the plant through the root

hairs. Of course, the acid radical to which the basic potassium ion is attached may, in itself, have some beneficial or deleterious influence which gives to the compound as a whole some important effect in one case, which might not follow in the case of another type of compound; but the relative efficiency as plant food of a given unit of potassium seems to be the same regardless of the nature of the compound in which it is present.

Chemical Analyses Show Needs

To some degree a perspective of the potential nitrogenous, phosphatic, and potassic supplies of Virginia apple orchard soils may be obtained from chemical analyses. Common orchard soil types in Virginia are the Hagerstown and Cecil soil series. The former lies between the Alleghany and the Blue Ridge Mountains, the latter south of the Blue Ridge. According to the HCl (specific gravity 1.115) method, there is present in soils of the Hagerstown series .06 per cent phosphoric acid and .545 potash. This would indicate an availability of 2,100 pounds of phosphoric acid and 19,075 pounds of potash to the acre foot. If all of this material is available to apple trees, there would be enough phosphoric acid to take care of the needs of 40 apple trees capable of producing 20 bushels of apples annually per tree for 191 years, and enough potash for 439 years. These soils also show about .09 per cent nitrogen to be available or 3,150 pounds per acre foot. This would provide enough nitrogen for 40 such apple trees over some 78 years.

Analyses of the Cecil series do not show such high amounts of phosphoric acid and potash. These are as follows based on HCl (specific gravity 1.115) test: for phosphoric acid .03 per cent and for potash .17. Nitrogen shows a content of .11 per cent. According to these percentages there should be available 3,850 pounds of nitrogen, 1,050 pounds of phosphoric acid, and 6,358 pounds of potash. The amount of nitrogen available should take care of the 40 apple trees mentioned for 98 years, the phosphoric acid for 96 years, and the potash for 150 years.

Using the more rigid test for availability, namely, the fifth normal nitric solution, less phosphoric acid and potash would be available for apple trees. In the Hagerstown series there are shown to be present on this basis of analysis 53 parts per million or 185 pounds of phosphoric acid, and 325 parts per million or 1,116 pounds of potash per acre foot. The Cecil soil series shows 23 parts per million or 81 pounds of phosphoric acid and 295 parts per million or 1,033 pounds of potash per acre foot.

The 40 apple trees according to these indications of availability in the Hagerstown series would be supplied with enough phosphoric acid for some 17 years and with potash for 25 years. In the Cecil series the phosphoric acid available would meet the needs of the 40 apple trees for 8 years and potash for 24 years. Accepting the more rigid test for availability, the two more common apple sections of Virginia show that on an average an acre has enough of the three essential elements to take care of 40 apple trees yielding a crop of 20 bushels annually on the following basis: for nitrogen between 75 to 98 years, for phosphoric acid between 10 to 17 years, and for potash between 23 to 25 years. How do these tests bear out in experimental observations, and how are certain responses of apple trees to different fertilizer applications involving these three essential elements to be reconciled on the basis of these soil tests for availability?

Among several observations that were taken from orchard fertility experiments there are two sets. The first set is a 25-year record of a 29-year experiment at Blacksburg, Virginia. Fertilizer experiments were started with these trees in 1912, the year after they were set out. These results include the responses of York, Stayman, and Winesap, some in cultivation and some in sod.

The fertilizer history of the 15 highest yielding trees of each of these varieties

(*Turn to page* 38)

Interested spectators followed the Illinois State Corn Husking Contest held near Danville, Illinois.

Don't Guess Yield

By H. L. Garrard

Chicago, Illinois

MORE than half (51.8%) of the farmers who guessed on the yield per acre of a block of corn, during the 1939 Illinois State Corn Husking Contest, missed the actual yield by 9 bushels per acre or more. Could you have done any better? Let's look at the figures.

The husking contest was held on the George M. Wright farm near Danville, Illinois. A block of corn was left standing near the edge of the field where the husking contest was held. This area of 310 hills was fenced off so that everyone could get close to the corn to look it over carefully. Husks were stripped back from all ears on outside rows to show type of ear as well as size. During the day 1,267 farmers estimated the yield per acre, recording their guesses on cards, along with names and addresses. In the afternoon the corn was husked out and weighed. The actual yield was 94.36 bushels per acre.

The guesses ranged from 45 to 133 bushels per acre. With the estimates arranged in 5-bushel groups, as shown in the table and accompanying graph, it was noted that the majority centered around the 85-89 bushel group. The average or mean of all guesses was 88.6 bushels, or *5.8 bushels below the actual yield*. About 71 per cent of all farmers estimated the yield too low. Only one farmer, Edward Redding, Weldon, Illinois, guessed 94.4 bushels, closest to the actual yield.

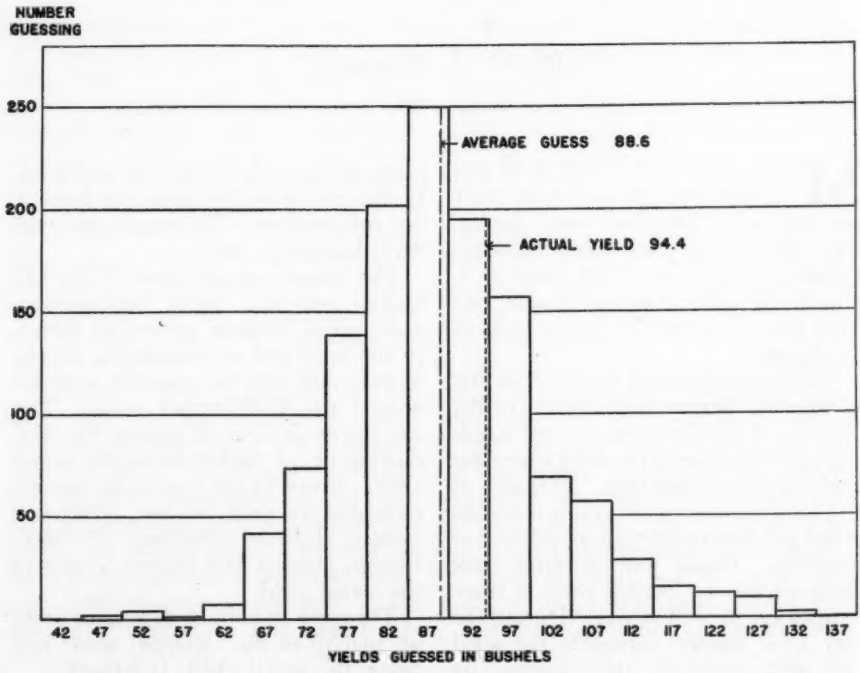
The most important data came from an analysis of the variations above and below the actual yield, as follows:

95.3%	missed	by	1	bu.	or	more
89.7%	"	"	2	"	"	"
83.4%	"	"	3	"	"	"
77.6%	"	"	4	"	"	"
72.2%	"	"	5	"	"	"
60.5%	"	"	8	"	"	"
51.8%	"	"	9	"	"	"
47.0%	"	"	10	"	"	"

According to statistical theory, the average of all farmers' guesses should have been near the actual yield. The theory did not hold true here. There must have been some deceiving factors which caused the majority to guess too low. First, this timber soil on the Wright Farm is lighter gray in color than some of the soils farther north and west in the State. It is possible that some visiting farmers thought the grayish timber soil might not be capable of making such high yields. A second confusing factor might have been the corn. This new hybrid (Pioneer 313) is apparently well adapted for that region. It has a good ear, with many two-eared stalks, but those stalks are only of medium height. At least there was more corn present than most people guessed, in spite of the fact the newspaper publicity had previously stressed that the husking contest field would yield about 100 bushels per acre.

Those farmers who underestimated the yield level of this field should not feel too badly. The writer, too, guessed 9½ bushels too low. Furthermore, he had been out all fall husking and weighing corn to determine yields in fertilizer demonstrations, and yet was not surprised to miss the yield by a large margin. He has guessed enough in the last few years to know that he cannot rely on yield estimates made "by the eye" alone.

County Agent Carroll Redfern of Donnellson, Iowa, conducted an interesting corn yield guessing contest, just before harvesting a fertilizer demonstration. Neighboring farmers were asked to look over the plots in a fertilizer demonstration and estimate the yield of each plot. The accompanying table shows the actual yields and the guesses.



RESULTS OF CORN YIELD GUESSING CONTEST, DONNELLSON, IOWA

No. Fertilizer	100 lb. 0–20–20	100 lb. 0–20–0
	Actual Yields	
54 bu.	70 bu.	62.5 bu.
	12 guesses	
35	40	38
36.1	40.2	39.1
37.4	58.6	52.3
45	44	42
45	57	55
47	52	55
50	60	65
50	73	60
50.5	56	58
52.3	61.4	60.5
53.8	60.3	57.5
55	60	65
	Average of 12 guesses	
46.4 bu.	55.2 bu.	54.0 bu.

Again the farmers underestimated the yields. They could see a difference due to the fertilizers, but could not agree as to whether the 0-20-0 or the 0-20-20 plot looked best. On this soil the corn responded noticeably in growth from the phosphate in the fertilizer. The 0-20-0 gave an 8.5-bushel increase, while the 0-20-20 produced 16 bushels increase.

Why are these facts and figures significant? The inability to estimate yields of crops accurately by appearance only, stresses the fact that *small but yet profitable yield increases* from various agronomic practices *often go unnoticed*. Erroneous conclusions may be drawn because these increases cannot be seen. It is not safe to guess crop yields when trying to measure small differences.

It costs less than $1 per acre to plant hybrid seed corn, the total cost being returned by only 2 or 3 more bushels per acre, to say nothing of other advantages. Likewise, 100 pounds of 3-12-12 fertilizer, costing about $1.85, would be paid for by 4 to 5 bushels of 40-cent corn.

When deciding which fertilizer grade to use (that is, what percentage of nitrogen, phosphoric acid, and potash), a farmer should buy the fertilizer to supply the plant foods needed regardless of cost per ton. The difference in costs per acre between grades is comparatively small. If more nitrogen is needed, one can use 3-12-12 instead of 0-12-12 for only 30 cents more per hundred. That is less than the value of 1 bushel of corn.

If one needs extra potash, it will cost only about 55 cents per acre to use 10% extra potash in corn fertilizers applied at 100 pounds per acre; for instance, 0-20-10 instead of 0-20-0, or 0-20-20 instead of 0-20-10. An increase of only 1½ bushels of corn will pay the bill, disregarding possible additional benefits on quality of corn or strength of stalks. It costs about 17 cents more per acre to apply 100 pounds of 2-12-6 instead of 2-12-2, or less than the value of one-half bushel of corn.

From the fertilizer salesman's standpoint it is commercial suicide to sell fertilizer to a farmer wholly on the basis of visible differences to be noticed in the fertilized crop. Such large differences are often quite evident, fortunately. But at the higher fertility levels, small but profitable differences may go unnoticed. In fact, it takes very careful work to check yields accurately enough to detect a 2-bushel increase from plant-food additions. Slight variations in natural soil conditions may make much larger differences. As the fertility is built up, 10-bushel increases of corn or potatoes will be less evident. Furthermore, residual benefits from fertilizers become less noticeable. The farmer applies fertilizers to replace plant-food losses and maintain that high fertility level, as well as to make a profit on his fertilizer purchases.

The residual benefit from fertilizers is usually given too little credit. A long-time Ohio test showed that when 500 pounds of 4-16-4 fertilizer were applied, only 40.5% of the return was obtained the first year, 30% the second,

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Conserving Soils And Their Fertility In the Northeast

By Grover F. Brown

Chief, Northeast Regional Agronomy Division, Soil Conservation Service, U. S. Department of Agriculture, Upper Darby, Pennsylvania

CIVILIZATION today is a complex organization of people living together under many conditions. To facilitate the smooth functioning of such a complicated organization, there must be many basic necessities regularly satisfied in specific quantities. People must have a sufficient amount and variety of food, clothing, and protection against the elements. Cities must be assured of pure water in plentiful quantities. Timber and wood are needed for manufacturing and home use. Protection of the people in cities, towns, and villages along the rivers and streams from the ravages of flood waters is becoming increasingly important. Water transportation and power depend upon a sufficient and constant supply of stream and river flowage. The need for recreation in our complex high-speed society is becoming more keenly appreciated, with thousands of people taking advantage of nature. Since the above needs of modern civilization are met largely from our soil re-

Contour orchard on terraces. The trees were planted in the spring of 1936, and the cover crop of rye and vetch has been disked down as a mulch, summer, 1938.

sources, the maintenance of the fertility of the soil is one of the most important problems facing farmers and urban dwellers today.

Soil Conservation is not a new idea, nor was it originally thought of by the Soil Conservation Service. It has been stressed by almost every soils textbook writer for years, and many farmers have known what was taking place, but didn't know what to do about remedying the situation. In 1895, B. E. Fernow, then Chief of the Division of Forestry of the U. S. Department of Agriculture, wrote in the Agricultural Yearbook a very complete article on erosion control, outlining the necessary land-use changes required in better farm planning, and the conservation practices which should be applied to the land. Mr. Fernow emphasized the fact that such soil and moisture-conserving practices as contour cultivation, strip cropping, and terracing, together with proper land use, were necessary before good general farming practices could be made most effective. It was recognized early that these practices were basically necessary, not only to dispose safely of the surplus rainfall, but to conserve an optimum amount of moisture for plant growth. The efficient use of applied fertilizers or organic matter followed as a corollary.

Plant production is both the basis and the end of erosion control, and in the achievement of this objective the technicians of the Soil Conservation Service value proper fertilization. They appreciate that in the Northeast, fertilizers are becoming increasingly important for the production of vegetation.

Adequate Vegetative Covering

Plant production is, therefore, of prime importance for reasons other than as a means of direct cash returns to the producer. Protection of the immediate ground surface from the beating action of driving rains by adequate vegetative covering has been shown to be as important in determining the amount of rainfall that can be absorbed and held by a certain soil as is the type of soil itself. This point becomes increasingly important as the variations in soil types increase. The farmer can do little to change the various types of soil upon his farm, but he can do much in the management of his soil to affect its producing power, its water-absorbing capacity, its water-holding capacity, and

This two-row tractor handles efficiently the contour cultivation of potatoes on the Ralph N. Johnson farm near Walpole, New Hampshire.

its resistance to damages caused by erosion.

One might consider contour cultivation, strip cropping, terracing, and other erosion-control practices as the framework upon which to hang a vegetative covering. Fertilizers may be regarded as one of the nails or means of fastening the roots of this protective covering to the land. Unless this framework is strong it will not hold the nails, and both the framework and the nails will be lost through run-off. With this loss, there is nothing to hold the vegetative covering to the land, with the final result that not only the plant covering is lost, regardless of whether this covering is cultivated crops, orchards, hay, or pasture, but the soil itself is lost.

Contour strip cropping on the A. A. Maxwell farm, Moundsville, West Virginia.

Control Surface Water

It is, therefore, a waste of fertilizers to place them on lands unless first consideration is given to holding the fertilizers in place until they can be used by the plants. This fact is not only important for the crop to which the fertilizers are applied directly, such as potatoes or corn, but also for the residual effect of such fertilizers upon the crops following. This is true particularly if such following crops serve as protective winter cover, and as binders for the soluble residual fertilizers which would otherwise be lost by leaching. In other words, the control of surplus surface water and the conservation of an optimum amount for crop production are basic considerations if the full benefit of fertilizers applied is to be secured.

There has been a great deal of interest shown in pasture improvement during the last few years. Well-fertilized pastures, with the grazing properly managed to maintain a dense, high-producing sod, give to the soil about the best protection against erosion that is known today. However, thousands of acres in the Northeast are too low in fertility to produce a good pasture, and many question the economics of attempting to bring the fertility up to a bluegrass—wild white clover level. Research activities are going forward to obtain species of grasses and legumes that, with the addition of only moderate amounts of lime and fertilizers, will grow on some of these poorer soils and make a profitable return to the farmer. The Soil Conservation Service recognizes the need for lime and fertilizer applications to pasture lands and has cooperated with all agencies concerned with the solution of this problem.

Soils are the basis of civilization. If we are to maintain this modern civilization, we must maintain the base. The

farmer, of course, is intensely interested in the future of the country, but he is more concerned with the immediate present or very near future, and any soil-conserving program must take this fact into consideration. This is not a job for any single agency working with agriculture, but the combined responsibility of each and every one. In view of the excellent markets available to the farmers of the Northeast, and the well-distributed annual rainfall, the conservation of the soil and moisture may well be considered as one of the most important agricultural problems now confronting the people.

Increase Fertilizer Efficiency

I can say nothing that better illustrates the seriousness of this problem than to quote Dr. Richard Bradfield, Head of the Agronomy Department, Cornell University.

"The extensive activities of the Soil Conservation Service have focused the attention of us all on the importance of erosion control to a permanent agriculture. The effect of erosion on the efficiency of fertilizer utilization is so manifest that further elaboration is unnecessary. Fertilizers cannot benefit the crop to which they are applied if they are washed away before the crop has had time to use them to the fullest extent. This applies especially to the accumulative residual effects of the fertilizers. It is also well known that profitable returns are frequently not obtained from fertilizers on soils that are normally responsive because of a shortage of moisture. Soil Conservation techniques which result in more efficient use of water will at the same time tend to increase the efficiency of fertilizers.

"The task of the agronomist in this program is to help the farmer tie all of the factors capable of increasing the efficiency of fertilizers into improved systems of soil and crop management. It is not a task that can be settled once and for all time. It will require the united efforts of both farmer and specialist over a long period of time." [1]

Types of farming that have suffered severely from soil and water losses have been orcharding and the production of grapes and small fruits. This has been particularly true where clean cultivation has been practiced over a large portion of the year. Peaches, as a class of fruit, have suffered most, and many sites have been practically ruined after one planting has completed its length of life on the site. Only one or two peach orchards in the Northeast were planted on the contour before the Soil Conservation Service began a few years ago to offer the technical and physi-

[1] Bradfield, Richard. The effect of developments in soil science upon fertilizer practices. The American Fertilizer, Vol. 91, No. 3, Aug. 5, 1939, pp. 5-8, 24, 26.

cal assistance to growers necessary in laying out orchards on the contour. As a result of the orchards being planted on the "square," cultivation took place up and down the slopes causing, in some cases, such a loss of topsoil and fertility that within a few years it was practically impossible to establish a winter cover crop.

The principal plant-food nutrient used by the fruit grower to stimulate tree growth has been nitrogen, and as a result, cover crops lacked the necessary lime, phosphorus, and potash. Tests made on various fruit soils have not shown economic response to phosphorus and potash applications to the trees, but both elements are essential for the satisfactory growth of cover crops in the orchard. Fertilization of the "orchard" instead of the "trees" would do much toward maintaining our favorable orchard sites through many generations of trees.

Contour planting of all new orchard blocks to facilitate necessary contour cultivation and installation of supporting engineering measures would help in controlling surface wash, conserve much-needed moisture, and give the protective cover crop an opportunity to utilize the fertilizers applied. The AAA program is giving some assistance to the solution of this orchard erosion problem by making payments for applications of lime and phosphorus to benefit the cover crops. Such practice payments as those made for mulching and the planting of various grass and legume covers are very desirable in assisting the grower to establish a soil and moisture-conserving program. More attention to the use of complete fertilizers in orchards, vineyards, and for small fruits would assist in maintaining adequate cover and would protect profitable, producing sites for many years to come.

Highway Clearance Expensive

State highway departments spend many thousands of dollars every year to repair the damages caused by erosion to their road banks and fills. The clearing away of soil washed upon highways during heavy rains has long been a constant maintenance cost that runs into rather startling sums of money. In a number of States, the Soil Conservation Service has cooperated with the highway departments in reducing this waste-

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Clearing away silt over the road caused by erosion of tobacco and corn field above. This was the result of one rain of 7.1 inches.

When Are Legumes Soil-Improving Crops?

By C. B. Williams

North Carolina State College of Agriculture, Raleigh, North Carolina

WHEN crops are grown on any land and after their growth they leave the land more productive for crops which follow, they are termed soil-improving. If the only limiting factor of a piece of land is poor physical condition of the soil, the growth on it of non-leguminous crops like rye, oats, and millet, and turning these under after growth, should aid in remedying this defect and thereby materially improve the productiveness of the soil. On the other hand, if the trouble with the soil is lack of sufficient quantities of any one of the essential constituents in available forms, like nitrogen, phosphoric acid, potash, lime, and magnesia, no reasonable amount of turning under of non-leguminous crops will be likely to make the soil a productive one.

In the former case, the only factor which was needed to be improved was the unfavorable physical condition of the soil which could probably be accomplished by the incorporation of organic matter, but in the latter case one or more essential available plant nutrients were present in too small quantities in the soil to permit the normal growth of crops with economic yields. In this latter instance no amount of purely organic matter added would correct the defect. It could only be remedied by the addition of the lacking constituent or constituents in available form to meet adequately the requirements of the growing crops.

The only class of crops that when turned under can gather and store in the soil any extra essential constituents needed in crop growth are the legumes, like soybeans, cowpeas, clovers, lespedeza, etc., when inoculated. The only constituent they can add to the soil when plowed in, other than what they took up from the soil, is nitrogen. These when cut and removed from the land will not ordinarily add any more nitrogen to the soil than they removed from it.

Legumes Remove Plant Food

This being the case, legumes grown on land and removed for hay or any other purpose can hardly be classed as soil-improving crops, since under such a system of management, the nitrogen supply of the soil will just about be maintained and there will be a loss of from 8 to 16 pounds of phosphoric acid and 26 to 54 pounds of potash from the available supplies of the soil for each ton of legume hay removed. To replace these two constituents in the soil and make them the same as they were at the beginning of the year, it would require the addition to the soil of from 50 to 100 pounds of 16 per cent superphosphate and 52 to 108 pounds of 50 per cent muriate of potash for each ton of legume hay removed.

It may be surprising to some growers to know that, generally, legumes grown and removed from the land are much more exhaustive upon the available phosphoric acid and potash reserves of a soil per hundred pounds of crop removed than are most other crops grown and removed. For instance, 100 pounds of soybean seed removed from the soil carries 3.07 and 5.33 times more respectively of these constituents than is removed by 100 pounds of the kernels

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Potash Keeps Tobacco Growing and Glowing

By E. R. McIntyre

Madison, Wisconsin

POTASH is well known for its ability to keep tobacco growing, but new Wisconsin tests show that it also keeps tobacco *glowing*. In other words, unless a tobacco plant is raised on soil with 500 pounds or more of available potash to the acre, its burning power is much reduced and its value becomes less for cigar-wrapper and binder purposes.

Burning quality means the length of time the leaf will keep aglow after being ignited. The Wisconsin horticultural and soils departments at the University in Madison use an electric ignition method of testing sample leaf from various farms and then make individual reports to the growers as to the complete analyses of the soil samples where grown, together with the burn test expressed in seconds of glow retained by the burning leaf.

Ordinarily data are taken on the burning period from zero to 60 seconds. The burning quality is rated low if the leaf glow dies down in less than 5 seconds after electric ignition. In some instances the crops of cigar binder submitted for these tests show an absolute zero in glow, while other leaf samples will continue to burn slowly until they are completely consumed. Similar tests are made with cigars, both machine and natural smoked, to check the burning and white-ash-retaining characteristics.

Reports rendered to each cooperating grower give him data on which to correct his soil balance in order to improve the valuable element of steady burn. There were especially well-marked relationships found in the burning quality, soil potash content, and the market prices quoted by dealers. That is, the higher average potash soils had much longer leaf-burn periods, and the margin on tobacco market prices between the region where potash content was high and where it was low averaged 6 to 7 cents per pound in favor of the leaf grown on the higher potash lands.

Take one such sample report as made in the fall of 1939 to 112 growers in each of two leading tobacco-growing regions or districts of Wisconsin, where commercial leaf has been a cash crop for 50 years. Both soils are silt loams. Region One has large farms, less manure available per unit of cultivated land, and the topography is gently rolling prairie. Region Two has many rough hills and sharp deep valleys subject to erosion and leaching, and no doubt the washing process has carried plant food down into the valley fields

	Acidity	Organic Matter (per cent)	Lb. Per Acre of			Length of Burn in Seconds
			Total Nit.	Avail. Phos.	Avail. Potash	
Average of Fields in Region 1.	Slight	3.7	3,168	90	393	1.2
Average of Fields in Region 2.	Slight	4.4	3,987	172	626	12.0

where the tobacco is always raised. Moreover, in Region Two the farms are smaller and there has been more stable manure available per unit of area under tillage, with probably more intensive fertilization.

Hence the general summary of the data taken from Regions One and Two show up this way in the reports sent to growers, with the exception that each separate farm had its own data added.

The accompanying comment was: "Slightly acid soils are not harmful to the growth of quality tobacco. A poor leaf burn can usually be accounted for because of low potash content and dry growing weather. A burn of 5 seconds or more is desirable for cigar binder."

The next step to be taken since distributing this convincing data on one sure cause of poor burning quality will be to set up demonstration plots at central points, particularly in Region One, to find out the best means of economically raising the potash content of the soils on which tobacco is raised.

In Wisconsin tobacco is maintained for 3 or 4 years or more on the same plot or field, and by use of disease-resistant varieties the disadvantage of using this old, well-tilled farm land for tobacco continuously is largely overcome. This leaves the grower in a better position to apply himself to a thorough study of his permanent plantation of tobacco and to use ways and means to maintain and increase its fertility—notably its potash content.

By annually rotating tobacco with other crops he would not be so certain of making successive improvements in the feeding of his crop to overcome poor burn and other undesirable things. Hence the data on the relation of leaf burn and potash availability may be applied on the same area where the tests were made last year to correct local conditions and secure higher unit prices for the 1940 crop, other things being equal and no drouth intervening.

Of course the physical nature of the soil, its water-holding capacity, the season's moisture reserves, and such things also have a bearing on leaf-burn values; but none of them alone possesses as much power to affect leaf glow as potash. And leaf glow means more saleable and more satisfactory cigar material.

Professor James Johnson, a student and a leader in Wisconsin tobacco science for 25 years, has this to say in summary of the experiments and the recent soil and leaf-burn tests made in the two commercial regions of the State:

"The potash content of these soils is of particular interest because of its relation to the burning quality of tobacco and the higher prices being paid for good burning tobacco by the cigar manufacturers in recent years. A good burn can hardly be expected in Wisconsin soils carrying less than 500 pounds of potash to the acre. There were 78 per cent of the Region

Testing the glow of leaf tobacco with an electric burner in the laboratory at the University of Wisconsin.

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Potash Makes Bank Accounts

By Lee VanDerlinden

Ottawa, Ohio

AUGUST MORMAN of Continental, Ohio, is a good farmer. He operates 120 acres with one large and one small tractor in use, in addition to a trio of fine horses. Ten very good Jersey cattle are milked, and Mr. Morman sells about 50 head of hogs per year. One son, A. W. Morman, helps in the farm operations. The land is very level and is exceptionally well drained. A 4-year rotation system is practiced consisting of corn, wheat, alfalfa, alfalfa, plus plenty of fertilizer to keep the soil in excellent tilth and fairly high plant-food content.

In March of 1939 Mr. Morman brought soil samples to us to be checked and to make fertilizer recommendations for a good crop of tomatoes. His soil assayed as follows:

6.6	pH Value
3,400	lb. Active Calcium
300	lb. Active Magnesium
20	lb. Available Phosphate
175	lb. Available Potash
.275	% Total Nitrogen

A study of these figures indicated the need of approximately 500 lb. of 0-20-20 broadcast, worked well into the soil. Total nitrogen content did not indicate a need for this element, and 500 lb. of 0-20-20 carries 100 lb. each of phosphate and potash. We called Mr. Morman's attention to the fact that 10 tons of tomatoes require 120 lb. phosphate and 105 lb. potash, and a good crop of 20 tons seldom attained in the Midwest, would consume 240 lb. of phosphate and 210 lb. of potash.

Knowing our farmers as we do, we hope only to educate them to use upwards of 500 lb. of 0-20-20 per acre on tomatoes, even though we realize the application of 1,000 lb. per acre is by far the best rate. Mr. Morman planned on growing 3 acres of tomatoes with an application of 500 lb. an acre. Through an error, the first quarter acre received 150 lb. or equivalent to 600 lb. an acre. The balance of the 3 acres was fertilized at the rate of 500 lb. an acre.

The writer was absent from the territory during part of the summer, but when Mr. Morman was visited late this fall for a check on results, he expressed himself as being sorry he did not use 600 lb. an acre on all the tomato land. Here are yield results.

From the quarter acre treated with 150 lb. 0-20-20 at the rate of 600 lb. per acre, he sold 6¼ tons of good fruit, or at the rate of 25 tons per acre. He sold 53¾ tons from the remaining 2¾ acres, which gave a yield of 19½ tons per acre. Apparently the law of diminishing returns had not been operative here, for 500 lb., 0-20-20 produced 19½ tons tomatoes per acre, while 600 lb. produced an additional 5½ tons per acre, or at the acre-rate of 25 tons.

No one was more surprised at this result than Mr. Morman and his son. This was not a planned experiment, but an accidental one. Mr. Morman, like hundreds of other farmers in Henry, Auglaize, Putnam, and Hardin Counties, has been accustomed to using 200 to 300 lb. of 2-8-10 or 2-12-6 on an acre of tomatoes. Even last spring (1939) many concerns, even the tomato can-

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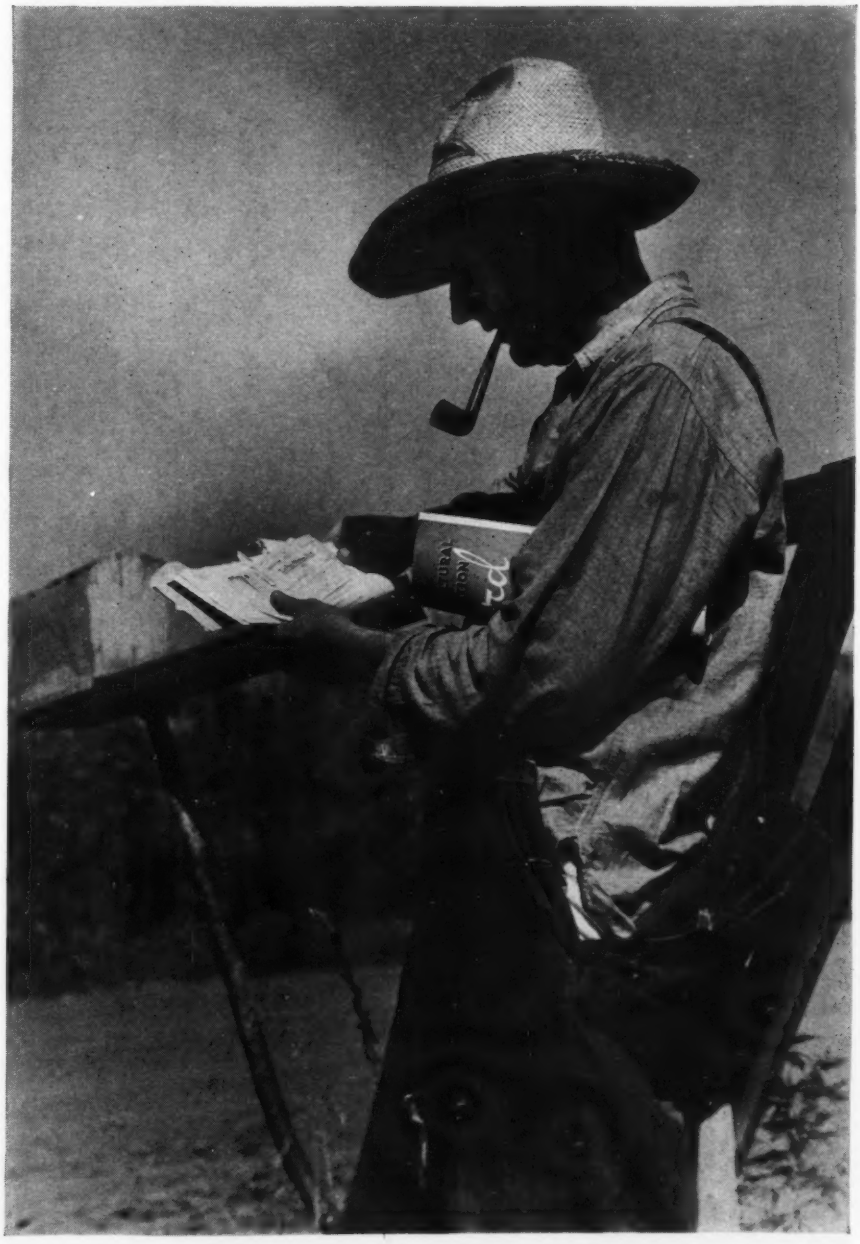
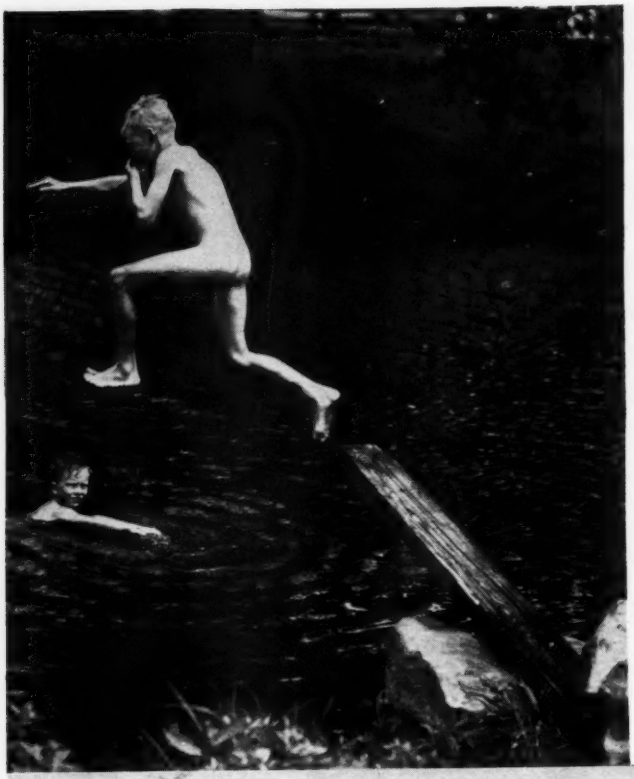
PICTORIAL



BILLS! BILLS! BILLS! BUT HARVEST IS COMING.

Summer

Landscapes



Left: Look out below!

Below: A sit-down strike.

The Editors Talk

Grass-land Conferences

That the renewed interest in grass-land farming in the United States is assuming importance is noted in the announcements of several regional grass-land conferences to be held this summer. Planned by the U. S. Department of Agriculture and the respective State colleges, the South will hold its conference at the Georgia Coastal Plain Experiment Station July 25-26 under the sponsorship of the Association of Southern Agricultural Workers. The Northeast meets at Pennsylvania State College on July 10-12 for a series of discussions sponsored by the Northeastern Section of the American Society of Agronomy. During the week of July 15, Western agronomists and the Forest Service will confer at Logan, Utah. The Corn Belt section of the American Society of Agronomy and Association of North Central Agricultural Experiment Station Directors will hold their regional grass-land conference at Ames, Iowa, on September 11.

The Southern Workers expect to consider the possible effects of the improvement, production, and utilization of greater quantities of Southern forage crops in the South. They will inspect grass-breeding and pasture-development projects which are being conducted in cooperation with the Division of Forage Crops and Diseases of the Bureau of Plant Industry. Discussions will center around such topics as the changing agriculture in the Southern regions, grass-land agriculture as a pattern for adjustment, soil conservation with grasses and legumes, and the nutritive value of grass-land herbage and its relation to adjustments in livestock production. Smaller groups will deal with such specific problems as grass-land improvement and management, better cover crops, better grasses for lawns, highways, and recreational grounds, and financing the adjustments in the trend toward a grass-land agriculture.

The increasing attention being given grass-land management may appear to many as something new in the continuous effort to better American agriculture. In that light, it was interesting to run across a report of what is believed to be one of the early meetings of the Vermont Dairymen's Association held at Burlington. This report was published in the February 10, 1877, issue of the "New England Farmer." According to the following excerpts, the maintenance of good grass-land in those days was a conference topic when thoughtful and foresighted farmers got together to work out their common welfare.

"We are told that the removal of the forests has changed our climate; that our hills are dried, our streams smaller and less durable, and our summer showers less frequent than formerly. Doubtless this is true to some extent, but this is not the only cause which has tended to diminish the productive capacity of our pastures, for we have driven our cows year after year to the same fields in the morning, and returned them to the barn at night, thus drawing con-

stantly upon our pastures for the materials which go to make bone, muscle, blood, and fat in the form of milk, butter, cheese, and meat.

"We have thus allowed one-half the waste material which belongs to the soil to be carried away from the pastures to enrich the mowing and tillage lands. We have drawn upon our pastures as men sometimes draw upon their bank account, not on the dividends alone, but year by year a little upon the deposit also, till finally they find their capital all gone; and so the question comes up, 'What shall we do with our pastures,' or rather 'What shall we do without our pastures?'

"While spending a few days the past summer with some of the best dairy farmers in your state, I found that these questions were becoming very important. I saw pastures which were once productive, now almost barren. Some were so steep that, unless protected by vegetation of some sort, the soil must constantly wear away by washing, till it finds a resting place in the valleys below. Some had been once ploughed where the inclination was so great that it was with the greatest difficulty that man and beast could retain a foothold while turning the furrows."

It goes without saying that interest in grass-land management now, even more than when the above report was written, involves an intelligent use of fertilizers. There is much information along this line available. More will come to light at the conferences. It is to be hoped that from this experimental and demonstrational work can be formulated recommendations of such practical nature that they will be accepted more widely by growers and ranchmen who see the need of turning to more grass-land farming.

A New Service

Fully aware of the great demands made upon the time of agricultural technical and advisory forces, and the vast amount of published material bearing upon their work with which they would like to keep abreast if time permitted, the American Potash Institute has inaugurated a new service designed for those interested in plant nutrition and more particularly in the role of potash in efficient crop production. The Institute maintains a library of some 85,000 books and pamphlets pertaining to soil fertility. In addition it receives 37 scientific magazines, the contents of which embrace world contributions to the agricultural science of potash use. The Institute Librarian will publish several times a year a "Bibliography of Literature on Potash as a Plant Nutrient" which will be sent gratis to anyone interested.

The first issue, covering literature reviewed from July 1, 1939, to September 30, 1939, is now available. It has three sections, the first being alphabetically arranged by crops. Next is a section arranged by subject under potash, and another by subject under soils. Each of these is also subarranged by place and author.

With an increasing indication of boron deficiencies in many soils to the point where its use in the control of certain diseases and to promote plant growth is being advocated and many articles giving results of experimental work are appearing, the Institute is now making available to technical workers "Boron as a Plant Nutrient," a bibliography of literature published and reviewed January 1936 through December 1939. This also is fully indexed.

From the responses already being received, it is apparent that these bibliographies are answering a definite need for this information. The Institute considers it a privilege to be in position to offer this service and hopes that those interested will avail themselves of it.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

¶ Pasture experiments in New Jersey have clearly demonstrated that there are several systems of fertilization which will produce feed on pastures more cheaply than feed of equal value can be purchased. According to New Jersey Agricultural Experiment Station Bulletin 673, "A Comparison of Treatments on Permanent Pastures," by H. B. Sprague, R. E. Blaser, and J. H. Boyce, the use of lime alone, phosphate alone, or potash alone has usually been found disappointing. On a majority of pasture soils in New Jersey, all three must be applied to produce satisfactory results. Experiments have also shown that nitrogen is required for best growth of pasture plants, but data have not been assembled to determine whether the nitrogen can be provided more conveniently and cheaply by encouraging clover and other legumes than by the application of nitrogenous fertilizers.

The authors state that probably the best system of treatment on many farms would be the heavy use of nitrogen fertilization (balanced with lime and minerals) on part of the pasture for early grazing and the application of lime, phosphate, and potash on the remainder. But in any system of fertilization, it is essential that the utilization of feed by grazing or harvest keeps pace with herbage growth, if the full value of the pasture is to be obtained.

A summary of the results obtained at New Brunswick and in Hunterdon County and the comparisons on 25 permanent pastures distributed throughout the State showed that there was a striking increase in palatability of the herbage on treated areas, particularly where clover had been increased in abundance. Observations for 3 years at the New Jersey Experiment Station revealed that clover was increased in abundance from 22 per cent on the untreated pasture to 36 per cent of the total vegetation on plots receiving lime, phosphate, and potash. The treatment of lime and complete fertilizer reduced the clover content to 14 per cent. It was further shown that the use of lime and minerals to stimulate clover increased yields 44 per cent over the untreated pasture. Growth after August 15 was increased 52 per cent by the lime, phosphate, and potash treatment. A comparison of potash used in conjunction with lime and phosphate showed this mineral to be exceedingly valuable, since the annual application of 50 to 75 pounds of muriate produced an increased yield of approximately 700 to 900 pounds of dried herbage per acre.

Periodic observations made on growth, clover abundance, and palatability of herbage on the other permanent pastures studied indicated similar responses to those noted at New Brunswick.

"1939 Cooperative Fertility Tests with Oats, Barley, Wheat, Mixed Grain, Potatoes, Turnips, Mangels," Ontario Agricultural College, Guelph, Ontario, Canada, Ext. Cir. 55, Mar. 1940.

"Recommendations of the British Columbia Fertilizer Board," Province of British Columbia, Victoria, B. C., 5M-340-4210, 1940.

"Pointers in Fertilizing Carrots," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, T. H., Agr. Ext. Cir. 68, Apr. 1940, Ashley C. Browne.

"Tomato Fertilization," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, T. H., Agr. Ext. Cir. 69, Apr. 1940, Ashley C. Browne.

"Head Cabbage Fertilizer," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, T. H., Agr. Ext. Cir. 71, Apr. 1940, Ashley C. Browne.

"A Preliminary Report on the Relative Value of Various Phosphate Fertilizers for Southern Idaho Soil Conditions," Agr. Ext. Serv., Moscow, Idaho, Ext. Bul. 120, June 1939, H. W. E. Larson and G. Orien Baker.

"How to Fertilize Cotton in Tennessee," Agr. Ext. Serv., Knoxville, Tenn., Pub. 235, Mar. 1940, H. E. Hendricks.

"Production and Agricultural Use of Sodium Nitrate," U. S. D. A., Washington, D. C., Cir. 436, Feb. 1940, Albert R. Merz, and C. C. Fletcher.

Soils

¶ Florida Agricultural Experiment Station Technical Bulletin 340, entitled "Chemical Studies on Soils from Florida Citrus Groves," by Michael Peech, gives a very interesting discussion of chemical data on representative soil types and in a general way evaluates the fertility of the various groups of soils planted to citrus. The results of chemical analyses included are for exchange capacity and the degree of base saturation; the exchangeable bases (calicum, magnesium, potassium, manganese, copper, and zinc); organic matter; total nitrogen, nitrate nitrogen, and the C/N ratio; and acid-soluble and water-soluble phosphorus. The soils investigated were collected from 100 groves in the various citrus areas of the State covering a wide range of grove conditions on different soil types. Adjoining four of the groves, samples of virgin soils were obtained for comparison.

The chemical data presented and briefly summarized show the variations in composition among the different soil samples within the same series, as well as the minimum, the maximum, and the average amounts of the various constituents found in the different soil series.

"Soil Survey of the Lower Fraser Valley," British Columbia Dept. of Agr. Cooperating with Experimental Farms Serv., Dominion Department of Agriculture, Ottawa, Canada, Pub. 650, Tech. Bul. 20, Oct. 1939, C. C. Kelley and R. H. Spilsbury.

"Soil for Flats and Cans," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, T. H., Agr. Ext. Cir. 66, Apr. 1940, Ashley C. Browne.

"An Electrical Resistance Method for the Continuous Measurement of Soil Moisture Under Field Conditions," Agr. Exp. Sta., East Lansing, Mich., Tech. Bul. 172, Apr. 1940, G. J. Bouyoucos and A. H. Mick.

"Soil Survey, Cerro Gordo County, Iowa," U. S. D. A., Washington, D. C., Series 1935, No. 13, Jan. 1940, J. A. Elwell, H. L. Dean, Foster Rudolph, and E. W. Tigges.

"Soil Survey, Scioto County, Ohio," U. S. D. A., Washington, D. C., Series 1933, No. 31, Feb. 1940, G. W. Conrey, A. H. Paschall, W. S. Mozier, Martin Leatherman, R. N. Durr, and Ivan Hodson.

"Effect of Accelerated Erosion on Silting in Morena Reservoir, San Diego County, Calif.," U. S. D. A., Washington, D. C., Tech. Bul. 639, Dec. 1939, F. F. Barnes, C. J. Kraebel, R. S. LaMotte.

"Rainfall Characteristics as Related to Soil Erosion," U. S. D. A., Washington, D. C., Tech. Bul. 698, Dec. 1939, David I. Blumenstock.

"List of Publications and Conservation Charts," U. S. D. A., Washington, D. C., SCS-B-1, Jan. 1940, H. H. Bennett, Chief.

Crops

¶ Professor J. B. R. Dickey, in Pennsylvania Agricultural Extension Circular 180, "Growing and Harvesting Alfalfa in Pennsylvania," says that alfalfa is the most efficient producer of high-class protein. This crop generally produces 50 per cent more hay per acre than the common clovers and is considerably higher in protein. Furthermore the protein has higher digestibility.

In this important publication Professor Dickey discusses briefly and concisely the major points that must be kept in mind to grow this valuable crop under Pennsylvania conditions. The discussions include soil and climatic requirements, liming, inoculation, differences in alfalfa seed and time of sowing alfalfa.

When seeding without a nurse crop on land not especially fertile, it is advisable to apply around 400 pounds of a fertilizer containing 2 to 4 per cent nitrogen and good percentages of phosphoric acid and potash. If manure is applied on the surface, or if the soil is very fertile, superphosphate may be all that is required. Where sown with winter or spring grain, the grain should be well fertilized. Fertilizer applied to the grain or new seeding should be

adequate for the first year or two the alfalfa is mown. Later, an application of 300 to 400 pounds of superphosphate, 0-12-15, 0-10-10, or similar material applied in the spring or after mowing has sometimes shown marked stimulation to growth and production and has greatly reduced the amount of winter injury.

The circular gives excellent advice on guides to determine when the alfalfa should be cut. When the new shoots appear from the crown of the root, the old growth is about completed and may as well be removed to make way for the new. Where long life of the stand is an important factor, cutting should be delayed until the alfalfa is at least half in bloom. Cutting too early will result in weakened roots and thinning stands.

Curing, pasturing alfalfa, and alfalfa to control weeds are also discussed.

"Cotton Production in Alabama," Agr. Ext. Serv., Auburn, Ala., Cir. 184, June 1939, J. C. Lowery.

"Handbook of Alabama Agriculture, 1940," Agr. Ext. Serv., Auburn, Ala., Apr. 1940.

"Vegetables for Prairie Farms," Dom. of Can. Dept. of Agr., Exp. Farms Serv., Ottawa, Canada, Pub. 663, Farmers' Bul. 83, Dec. 1939, W. R. Leslie and W. Godfrey.

"Tobacco in British Columbia," Dom. of Can. Dept. of Agr., Exp. Farms Serv., Ottawa, Canada, Pub. 669, Farmers' Bul. 87, Jan. 1940, A. J. Mann.

"Diseases and Decays of Connecticut Tobacco," Agr. Exp. Sta., New Haven, Conn., Bul. 432, Feb. 1940, P. J. Anderson.

"Flowering, Fruiting, Yield and Growth Habits of Tung Trees," Agr. Exp. Sta., Gainesville, Fla., Bul. 343, Feb. 1940, R. D. Dickey and Walter Reuther.

"How to Grow Good Head Cabbage Seedlings," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, T. H., Agr. Ext. Cir. 70, April 1940, Ashley C. Browne.

"20 Rules for Potato Growing in Iowa," Agr. Ext. Serv., Ames, Iowa, Ext. Cir. 254, May 1939, C. L. Fitch.

"Pasture Improvement and Management," Agr. Ext. Serv., Ames, Iowa, Bul. P8, Mar. 1940, H. B. Cheney.

"Planting Forest Trees," Agr. Ext. Serv., Orono, Maine, Cir. 134 (Ext.), Mar. 1940, A. D. Nutting and R. I. Ashman.

"The Hay Crop," Agr. Ext. Serv., Amherst, Mass., Leaf. 4, Oct. 1939, Ralph W. Donaldson.

"Potato Growing," Agr. Ext. Serv., Amherst, Mass., Leaf. 20, Oct. 1939, Ralph W. Donaldson, Oran C. Boyd, and Arthur I. Bourne.

"Growing Onions," Agr. Ext. Serv., Amherst, Mass., Leaf. 118, Oct. 1939, Grant B. Snyder.

"Ladino Clover," Agr. Ext. Serv., Amherst, Mass., Leaf. 144, Oct. 1939, Ralph W. Donaldson.

"Fiftieth Annual Report, Agricultural Experiment Station of the New Mexico College of Agriculture and Mechanic Arts," Agr. Exp. Sta., State College, N. Mex., 1938–1939.

"Pasture Management," Agr. Ext. Serv., Fargo, N. Dak., N. Dak. Conservation Series.

"Progress of Agricultural Research in Ohio 1937–1938, Fifty-seventh Annual Report of the Ohio Agricultural Experiment Station, for the Year Ending June 30, 1938," Agr. Exp. Sta., Wooster, Ohio, Bul. 600, Feb. 1939.

"State of Ohio Official Report of the Division of Plant Industry," St. Dept. of Agr. Columbus, Ohio, 1939, Stanley E. Laybourne, Chief.

"Growing Snap Beans for Market and for Manufacture," Agr. Ext. Serv., Corvallis, Oreg., Ext. Cir. 341, Dec. 1939, A. G. B. Bouquet.

"Fifty-second Annual Report of the South Carolina Experiment Station of Clemson Agricultural College, for the Year Ended June 30, 1939," Agr. Exp. Sta., Clemson, S. C., Dec. 1939.

"Growing Strawberries in Vermont," Agr. Ext. Serv., Burlington, Vt., Brieflet 555, April 1940, Charles H. Blasberg.

"Report of Agricultural Research and Other Activities of the Western Washington Experiment Station for the Fiscal Year Ended March 31, 1939," Agr. Exp. Sta., Puyallup, Wash., Dec. 1939, J. W. Kalkus.

"Production of Pumpkins and Squashes," U. S. D. A., Washington, D. C., Leaf. 141, Feb. 1940, Ross. C. Thompson.

"Protecting Field Borders," U. S. D. A., Washington, D. C., Leaf. 188, Dec. 1939, Verne E. Davison.

Economics

¶ The Clemson Agricultural College, Fertilizer Department, has recently issued their semi-annual summary of fertilizer and fertilizer materials sold in South Carolina. The period covered is from July 1, 1939, to December 31, 1939. Presumably this is to be a regular service of the Department in the future and should be greatly appreciated by those interested in the fertilizer industry. The next semi-annual report of the same nature will cover the period January 1 through June 30, 1940.

According to the report for the last half of 1939, total NPK fertilizer mixtures sold amounted to 15,682 tons, and the total P and K mixture amounted to

1,793 tons, customers' mixtures 265 tons, and materials 12,717 tons. The leading analysis in point of tonnage was 4-7-5 followed by 3-8-5, 2-10-4, 3-10-3, and 4-8-4.

¶ According to the recent mimeographed report of the Department of Agronomy, New York State College of Agriculture, fertilizer tonnage in 1939 in New York amounted to 318,992 tons. This consisted of mixed goods of less than 20 units, 41,765 tons; mixed goods of 20 to 30 units, 123,655 tons; over 30 units, 8,049 tons; and total units not indicated, 5,940 tons. The total of mixed goods was 179,409 tons. Sales of superphosphate amounted to 116,068 tons, nitrogenous materials 19,073 tons, potash salts 1,895 tons, and other fertilizer materials 2,548 tons.

¶ Bulletin 417, entitled "Registration, Labeling and Inspection of Commercial Fertilizers, 1939," issued by the College of Agriculture at Columbia, Missouri, contains a number of interesting facts relative to the fertilizer industry in Missouri. According to the Bulletin 54,443 tons of fertilizer were sold in 1939, 17,543 tons were sold in the spring, and 36,900 in the fall. The leading fertilizer-consuming counties are Greene, St. Louis, Jasper, Lawrence, Barton, and Dunklin, all of which use approximately 2,000 tons or better. It was estimated that the plant-food consumption in the State amounted to 898 tons of nitrogen, 8,369 tons of available phosphoric acid, and 1,273 tons of potash. The leading grades of mixed fertilizers were 2-12-2, 2-12-4, 2-12-6, 4-12-4, and 4-16-4.

"Supplemental List, Commercial Fertilizer Registrants to Date for Fiscal Year Ending June 30, 1940," St. Dept. of Agr., Sacramento, Calif., Bu. of Chem. Announcement FM-3, Mar. 26, 1940, Dr. Alvin J. Cox, Chief.

"Re: Vitamin B_1," St. Dept. of Agr., Sacramento, Calif., Bu. of Chem. Announcement FM-4, Apr. 25, 1940, Dr. Alvin J. Cox, Chief.

"Statistics of the Sale and Use of Commercial Fertilizers in California in 1938 and 1939," St. Dept. of Agr., Sacramento, Calif., Bu. of Chem. Announcement FM-5, Apr. 27, 1940, Dr. Alvin J. Cox, Chief.

"Basic Data for Land Classification," Agr. Exp. Sta., Moscow, Idaho, Bul. 232, Dec. 1939, Paul A. Eke.

"The New York State 1940 Agricultural Outlook," Cornell Univ. Agr. Ext. Serv., Ithaca, N. Y., Bul. 425, Jan. 1940.

"Report of Analyses of Commercial Fertilizers Sold in New York State, July 1, 1938 to June 30, 1939," St. Dept. of Agr. & Mkts., Albany, N. Y., Bul. 327, Part 1, Mar. 1940.

"Report of Analyses of Samples of Lime Materials Used for Agricultural Purposes Sold in New York State, July 1, 1938 to June 30, 1939," St. Dept. of Agr. & Mkts., Albany, N. Y. Bul. 327, Part 11, Mar. 1940.

"Cotton Prices in Relation to Cotton Classification Service and to Quality Improvement," U. S. D. A., Washington, D. C., Tech. Bul. 699, Nov. 1939, L. D. Howell and Leonard J. Watson.

"Marketing Commercial Lettuce," U. S. D. A., Washington, D. C., Tech. Bul. 712, Jan. 1940, Raymond L. Spangler.

"How Farmers in Hawaii Can Participate in the 1940 Agricultural Conservation Program," U. S. D. A., AAA, Washington, D. C., IR-40-1, April 19, 1940, H. B. Boyd.

"1940 Agricultural Conservation Program, North Central Region," U. S. D. A., AAA, Washington, D. C., NCR-401, Mar. 15, 1940.

"Conserving Soil Through the Farm Program," U. S. D. A., AAA, Washington, D. C., SRAC-No. 6, Dec. 1939.

"1940 Agricultural Conservation Program—Kentucky," U. S. D. A., AAA, Washington, D. C., ECR-401-Ky., Dec. 1939.

"1940 Agricultural Conservation Program—Maryland and Delaware," U. S. D. A., AAA, Washington, D. C., ECR-401-Md.-Del., Dec., 1939.

"1940 Agricultural Conservation Program—North Carolina," U. S. D. A., AAA, Washington, D. C., ECR-401-N. C., Dec. 1939.

"1940 Agricultural Conservation Program—Tennessee," U. S. D. A., AAA, Washington, D. C., ECR-401-Tenn., Dec. 1939.

"1940 Agricultural Conservation Program—Virginia," U. S. D. A., AAA, Washington, D. C., ECR-401-Va., Dec. 1939.

"1940 Agricultural Conservation Program—West Virginia," U. S. D. A., AAA, Washington, D. C., ECR-401-W. Va., Dec. 1939.

"Arizona Handbook," U. S. D. A., AAA, Washington, D. C., 40-Ariz.-1, Jan. 1940.

"California Handbook," U. S. D. A., AAA, Washington, D. C., 40-Calif.-1, Jan. 1940.

"Colorado Handbook," U. S. D. A., AAA, Washington, D. C., 40-Colo.-1, Jan. 1940.

"Idaho Handbook," U. S. D. A., AAA, Washington, D. C., 40-Idaho-1, Jan. 1940.

"Kansas Handbook," U. S. D. A., AAA, Washington, D. C., 40-Kans.-1, Jan. 1940.

"Montana Handbook," U. S. D. A., AAA, Washington, D. C., 40-Mont.-1, Dec. 1939.

"Nevada Handbook," U. S. D. A., AAA, Washington, D. C., 40-Nev.-1, Jan. 1940.

Potash Keeps Tobacco Growing and Glowing

(*From page* 21)

One soils in 1939 which showed less than 500 pounds of available potash to the acre. Only 22 per cent showed a potash content of over 500 pounds, but of these, two farms had soils showing as high as 1,250 pounds to the acre, showing that in farm practice it is quite possible to build up the potash content to higher amounts.

"The soils in Region Two, which on the whole produce a better tobacco, showed approximately 50 per cent with 500 pounds or over of potash to the acre. Growers who desire to raise the potash content of their soil are advised to plan on liberal manuring along with the use of a commercial fertilizer high in potash and applied at the rate of 500 to 1,000 pounds to the acre."

Growing Plants Without Soil

A Book Review

THE wide interest in the growing of plants in water and sand culture has created a demand for practical and non-technical information on how to do it. To help fill this demand, D. R. Matlin, of the Belmont Evening High School, Los Angeles, California, has written the book, "Growing Plants Without Soil" (Chemical Publishing Co., Inc., New York, N. Y., 1939, $2.00). A general introductory background of the practice of water culture is followed by chapters on the possibilities and advantages of growing plants in this way. Directions for preparing nutrient formulas, construction of tanks, and necessary precautions to maintain favorable growing conditions are given. The remaining chapters are devoted to making cuttings of plants, plant growth substances, vitamines, grafting, construction of greenhouses, and symptoms of nutrient deficiency and excess. The Appendix makes up the latter half of the book, in which will be found a wide variety of interesting and useful tables, but many of them are only distantly related to the title.

The author has covered the subject matter in a very condensed and concise manner, most chapters taking only two or three pages. For those desiring a non-technical book giving the bare essentials of water or sand culture without details this volume should prove very satisfactory.

When Are Legumes Soil-Improving Crops?

(*From page* 19)

of corn plants. Cowpea seed take from the soil 1.05 and 3.43 times more on an average of phosphoric acid and potash respectively than do wheat seed. In the case of equal quantities of hays, soybeans removed from the soil 1.36 and 1.86 times more of these constituents respectively than does the hay of redtop, while lespedeza hay removes 1.34 and 1.18 times the amount of them respectively taken off in timothy hay. Soybean vines are 3.08 and 1.78

times as exhaustive respectively of the phosphoric acid and potash supplies of the soil when removed than is wheat straw, and 2.23 and 1.56 times more of a drain upon the supplies of these constituents on the available soil reserves respectively than is the removal of an equal quantity of oat straw.

From the above comparisons, it is readily seen that if legumes are grown on land and then systematically removed, they prove to be not soil-improving crops, but will be even more exhaustive of the available supplies of phosphoric acid and potash contained in the soil than most any of the other crops commonly grown on the farms of the South.

In order that the growth of legumes shall be a help in building up the productiveness of any land, at least a goodly portion of them grown shall be turned back into the land either in their entirety or after picking or harvesting the seed. The crop then will prove beneficial, when properly inoculated, not by adding to the supplies of available phosphoric acid, potash, and lime of the soil which it cannot possibly do, but by adding organic matter, which many of our soils need, and by increasing the quantity of nitrogen stores of the soil.

Don't Guess Yield

(*From page* 13)

17.4% the third, and 12.1% the fourth year after application.

In England it has been customary for tenants who move from a farm to get credit for part of the limestone, phosphate, and potash which they have helped to purchase in recent years. The schedule goes about as follows:

Material Applied	Fractional Residual Values Assumed to Remain in Soil at Certain Times After Application				
	1 yr.	2 yrs.	3 yrs.	4 yrs.	5 yrs.
Phosphates	2/3	1/3	1/9	.....	.....
Potash	1/2	1/4	.....	.....	.....
Limestone	5/6	2/3	1/2	1/3	1/6

Although one cannot predict how much residual benefit may accrue from fertilizer applications, it is certain that if increased crop yields the first year are only equal to the fertilizer costs, then the farmer is more than even. He has maintained the plant-food supplies in the soil, and may expect some residual benefits in future crops.

At the higher yield levels it is difficult to see small but profitable increases from any of several farm practices. For instance a farmer cannot afford to try out inoculation of soybean seed, and then decide that inoculation does not pay, just because he could see no great improvement in the growth of the beans. It requires only a small increase of soybean hay or seed to repay inoculation costs. Furthermore, consideration must be given to indirect residual benefits for future crops due to nitrogen fixation from the air following nodule formation.

Before drawing definite conclusions from comparisons of two or more fertilizer grades, rates of fertilization, rates of seeding, or between strains or varieties of crops, farmers should be sure that accurate and fair yield determinations have been made. That is the only way of assuring conclusions which will put money in their pockets in future seasons.

Conserving Soils and Their Fertility In the Northeast

(*From page* 18)

ful expense resulting from such damages. Demonstration and test areas have been laid out on representative sections of highways in order to obtain more data on the seeding mixtures, rates of seeding, kinds and amounts of fertilizers to use, and other factors bearing on the establishing of a protective covering of vegetation on these slopes. The amounts of lime and fertilizers to use under these conditions are not so well known as for cropland or pastures, and the need is probably greater. Much of the run-off from highways collects in drainageways and cuts across adjacent crop fields, causing a great deal of damage to the farms along the highways, and in many places water from adjoining farm lands concentrates along the highways, causing considerable damage to them.

Soil-conserving Practices

The Soil Conservation Service has recognized applied fertilizers as tools with which to work in controlling erosion. Fertilizers are a necessity in establishing protective covers in all permanently vegetated areas, such as pastures, waterways, and hay fields. They are also necessary to maintain maximum production of cultivated crops on the more level areas of the farm, in order that steeper fields may be taken out of these crops. At the same time, soil-conserving practices hold applied fertilizers from washing away before the plants can use them, and also conserve moisture so that the greatest efficiency of such fertilizers may be realized.

Some of the State experiment stations are assisting in determinations of soil needs by making analyses on samples submitted. Where the facilities to render this service are not available at the stations, the field technicians have been forced to the use of quick field tests to supplement their judgment on the needs of a particular field. There is an increasing need to supply this type of service to the farmer as his appreciation for the value of lime and fertilizers develops. Most farmers do not have any too much money to invest each year for lime and fertilizers, and it is important that their money be spent on those plant nutrients most urgently needed and which will return them the most for their money, not only for the present but also in view of their long-time program. Every effort possible is made by the technicians of the Soil Conservation Service to make their fertilizer recommendations in accord with those of the various agricultural experiment stations.

The amount of organic matter in the soil directly affects the effectiveness of soil and moisture conservation measures. It has an important part in increasing the water-holding capacity of the lighter soils, and it also loosens and aids in the granulation of the heavier soils, thereby allowing the soil to absorb more water, with a consequent reduction of run-off which in time reduces erosion. The wise use of barnyard manure, green manure crops, cover crops, and legume and grass hay residues is fundamental in a sound soil and water-conserving program. Every complete erosion-control plan made for a farm takes into account the utilization of all available forms of organic matter a farmer might have to further the safe and profitable use of his soils.

It has been estimated that approximately 21 times more plant-food nutrients are lost as a result of erosion than are used by plants. According to the figures released in the Agricultural Yearbook for 1937, there were 1,209,185 tons of liming materials and 1,444,000

tons of fertilizers used by the farmers in the Northeast. Farmers in the Northeast have a long fight ahead of them, before a balance is established between fertility added to the land and the loss through erosion and plant production.

Lime, Phosphorus, Potash

In considering soil amendments, the technicians of the Soil Conservation Service give first consideration to the soil's need for lime. Lime not only acts as a plant food but also may modify soil structure. The modification of soil structure is often correlated with increased moisture absorption and resistance of the soil to erosion. This is particularly true in the case of increased flocculation of heavy clay soils that are more inclined to be slow to absorb rainfall. There may be a question regarding the direct benefits on this point under practical field operations, but the indirect effects, through increased plant growth, and the resulting effect of root growth, biological activities, and addition of organic matter to the soil are very important.

Phosphorus in particular is an important ingredient to consider in the fertilizer mixture, from the permanent or long-time point of view. Because it remains in the soil over a long period of time, unless lost by erosion, one economically can consider building up a reserve in the soil. One of the greatest losses of phosphorus from many soils is by erosion, and yet the application of available forms of phosphorus stimulates root development of vegetation, which protects the soil against erosion. Proper applications of phosphorus to harvested crops are recognized as a soil-conserving measure, just the same as applications to pastures. The higher the yields of cultivated crops, the heavier the drain on the phosphorus content of the soil and, unless applications are made sufficient to maintain an adequate supply, lower yields with increasing losses in topsoil will occur.

There appears to be an increasing need for potash in many fertilizers throughout the Northeast. This is not only true with such crops as potatoes and truck crops, but favorable responses have occurred from applications of potash to general crops. Potash deficiency symptoms have been found in leaves of fruit trees on certain soils in the Northeast. Response to potash fertilization, under such soil conditions, should be more rapid in the case of peaches than apples. With a different viewpoint regarding the use of orchard cover crops as a factor in conserving soil and moisture, applications of potash for the direct benefit of the cover crop may change somewhat the appreciation of this plant nutrient in orchard soil management.

For Protection and Profit

Under many conditions, in the soil conservation plan for an individual farm, it is necessary to seed areas to a permanent type of vegetation. This is particularly true in connection with terrace outlets, diversion ditches, grassed waterways, and areas retired from cultivation to hay or pasture. In most cases, the fertility of such areas is very low and, to insure a successful erosion-resisting stand of vegetation, a treatment of lime and complete fertilizers is recommended. It is important that the farmer appreciate the fact that initial applications are only to get such vegetation established and future top-dressings will be necessary to maintain desirable plant population to protect the soil and make a profitable return.

Individual action and resources have not protected our material resources nor maintained the individual's standard of living. Concerted planning and action by public agencies have been necessary to meet this situation. It is recognized that the conservation of soil and water alone is of no value unless such conservation affects people favorably. In the final analysis, conservation of people is the important objective in dealing with this broad problem. The Soil Conservation Service was organized to give technical assistance to farmers in making their change from an exploita-

tive type of farming to a conserving type, having the same or better economic returns for money and efforts expended.

In the past, emphasis has been mainly on the educational phases of soil erosion, with inadequate facilities for obtaining data bearing on the problem. With the birth of the Soil Erosion Service in the U. S. Department of the Interior, and later the Soil Conservation Service of the Department of Agriculture, funds were made available not only for securing definite data on the extent of past erosion in the various States, but also on the loss of soil and moisture taking place under present systems of farming. Soil erosion experiment stations were installed at State College, Pa., at Arnot, N. Y., in 1934, and at Beemerville, N. J., in 1936, in cooperation with the respective State agricultural colleges, to study soil losses under various cropping conditions and to determine methods for the control of such soil and moisture losses. Other sub-branches of these original soil erosion experiment stations have been set up since then, to study detailed problems bearing on the broad subject.

In 1934, demonstration areas were started in problem areas in some of the States, seeking to apply the known control measures to practical farm operations. This was the first attempt to demonstrate, on a large scale, how rainfall could be conserved and how surplus water could be carried safely from the fields with the least damage to the soil. Naturally, the farmers cooperating with such a program of demonstration needed not only technical advice and information, but physical assistance in rearranging their farm plan to conform with control practices. The Soil Conservation Service, through their technicians and the facilities of the CCC, was able to assist farmers in making these changes in fence locations, field boundaries, strip-cropping layouts, and in construction of the necessary engineering.

This ruinous silting in gully was the result of a single rain. Two inches of rainfall with a maximum of .75 in 3 hours.

The Agronomy Division of the Soil Conservation Service in the Northeast has held annual conferences with the members of the agronomy staffs of the

Universities, to work out technical approaches to the solution of the common problems. Many of these problems deal with kinds and amounts of the different fertilizers to use, seed mixtures, crop rotations, pasture management practices, strip cropping, and the use of contour cultivation. This cooperative effort has not only improved the technique of everyone concerned, but has forwarded the program very materially.

In the Northeast, during the last few years, the States of Vermont, New Jersey, Pennsylvania, Maryland, New York, and West Virginia have passed laws enabling farmers to form legally organized districts to carry on the fight against erosion. The individual farmer alone cannot always solve his erosion problem, but collectively, he and his neighbors can pool their resources and, with the assistance of local, State, and Federal agencies, effectively work out a solution. The soil conservation districts are set up within more or less natural boundaries and are organized and operated by the farmers and landowners themselves for the benefit of every farm concerned. At the present time in the Northeast there are 16 districts formed that are asking for assistance in their efforts to control soil erosion and conserve the soil.

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3 in 1 Fertilization for Orchards

(*From page* 10)

shows that for Yorks the higher yields are noted for nitrogen alone and the controls to 1924 when the trees were 12 years old. The controls are in the more fertile situations, which most likely accounts for their earlier relatively higher response.

In Stayman one of the nitrogen plots shows the higher yields up to 1926 or the 15th year. In the Winesaps the three nitrogen sets were to start within the more fertile spots. The results of this better fertility seems to persist up to date. The nitrogen-potash plot was far less fertile to start with, as were all of the other combination plots, than those receiving nitrogen alone. The Winesap set does not show the more pronounced earlier effect from nitrogen alone as is indicated in the York and Stayman set. From the York and Stayman set it would appear that some improvement developed after the 12th and 16th year when either phosphorus or potash or both were used with nitrogen. In all of the three varieties the highest yielding tree is a *nitrogen-potash combination*. In the Yorks 10 out of the 15 highest yields were some combination of nitrogen with phosphorus or potash or both. In Winesaps 12 out of 15 of the highest yielders were likewise some combination of nitrogen with phosphorus or potash or both. In a general way as far as the observations are concerned, the highest yielders are found in some combination of nitrogen with phosphorus or potash or both. It is hardly possible to analyze these facts statistically for significance. However, the association existing here between the cream of yielders and nitrogen combinations with the other two elements in one form or another would lead one to attach some importance to the possible value of fertilizer treatments other than nitrogen without phosphorus and potash, particularly in older trees or those that commence to show crowded competing root systems.

In some cases covering 21 years at Blacksburg, Virginia, in the experimental plots which included these three sets of 15 highest yielders, the averages of the variously treated plots show the higher growths and yields for nitrogen alone as compared to complete fertilizer applications. Much of this is

due to the favored position of the nitrogen alone plots with far more initial fertility as compared to the complete fertilizer treatments. In spite of their less favorable soil and position, the complete fertilizer plots ultimately showed higher rates of gain both in growth and yields. Over the entire 21 years, Stayman trees treated with nitrogen alone showed a total gain of 3.08 inches circumference increase, 62 per cent of which was made in the first 11 years but only 38 per cent in the last 10 years. Another set of Staymans showed a total gain of 6.55 inches, with 75.6 per cent of the gain in the first 11 years and only 24.4 per cent in the last 16 years. With a similar comparison for a case in York trees, there was a total gain of 4.03 inches of circumference increase for those receiving nitrogen alone, with 61.3 per cent of the gain showing up the first 11 years and only 38 per cent the last 10 years.

A higher rate of increase of the handicapped, complete-fertilizer plots to the level of the favored plots receiving nitrogen alone was also observed with terminal growth measurements. Stayman with a total gain of 9.5 inches terminal growth over a period of 21 years for nitrogen alone showed 53.7 per cent of the gain taking place the first 11 years and only 46.3 per cent the last 10 years. Another case in Stayman showed over the same period a gain of 8.4 inches terminal growth for nitrogen alone, with 76.2 per cent of the gain taking place for the first 11 years and only 23.8 per cent the last.

In one case with Yorks the handicapped complete-fertilizer plot caught up with the level of the favored nitrogen-alone plots. The total terminal growth gain in favor of the nitrogen-alone plot for the 21 years recorded was 19.8 inches. This entire gain occurred in the first 11 years, after which the trees in the complete-fertilizer plots caught up with the much more favored plots receiving nitrogen alone.

The significant observation in the cases mentioned is that in the 17th and 18th years the trees treated with complete fertilizers, in spite of their handicaps, made better rates of growth than those receiving nitrogen alone. According to this rate the prospects are that they may show even better growth responses later. The most interesting observation is that the gains of the favored nitrogen-alone plots began to recede at just about the same time that the complete-fertilizer plots started to outyield the other treatment.

Certain aspects of yield responses are brought out in table I. In this table, beside the actual yields, sliding averages over a 5-year basis were computed to smooth out the yield distribution over the 20 years of records. These sliding averages overcome the abruptness in yields that occurs from year to year especially with Yorks, thus making it more possible for a smoother comparison between the two different distributions arrayed against one another.

Complete Fertilizer Gains

It will be noticed that the Stayman apple trees in the complete fertilizer treatment commence to show yield gains over nitrogen alone after the 14th year (1925); the York trees after the 18th (1929). This corresponds as a general trend with a similar tendency for the growth gains to become higher for the complete fertilizer treatments as the trees have become older.

From these observations it would appear that better comparisons are to be found as trees become older and the soil becomes more heavily occupied with their root systems. Such was found to be the case in a 21-year-old orchard of Yorks, Stayman, and Grimes planted only 25 feet apart. Although the soil in this orchard is of average fertility, the growth and yields practically stopped in the 10th year. After that the yields dwindled down to about 1¼ bushels per tree for Stayman, 1 bushel for Yorks, and about 1¼ bushels for Grimes. At the time the fertilizer treatment was started, the terminal growth averaged a little more than 1½ inches. After one season of treatment,

marked responses showed up from nitrogen-phosphorus-potash combinations as compared to nitrogen alone. In some cases the yields for complete fertilizer combinations were over five times that of nitrogen alone.

These points are mentioned not as conclusive, clear-cut evidence, but to indicate conditions under which there is a tendency to show direct responses to phosphatic and potassic fertilizer in combination with nitrogen. Such tendencies seem to develop with apple trees as they become larger and more root crowded. At any rate, more marked direct responses from such fertilizer mixtures show up in closely planted trees with very crowded root systems even when planted in soils that show sufficient nitrogenous, phosphatic, and potassic content to take care of apples for at least a century.

Interactions Promote Growth

Several observations made as a result of applications of nitrogenous, phosphatic, and potassic mixtures indicate that interactions develop between nitrogenous and phosphatic and nitrogenous and potassic fertilizers that promote more marked growth and yield. This is very marked in mixtures of calcium cyanamide, of urea, and of ammonium sulphate with acid phosphate and also potash.

Among the products of decomposition of such materials as calcium cyanamide, urea, and to some extent ammonium sulphate, is free ammonia. Although in a very limited way ammonia in its free state is an effective nitrogenous fertilizer, as such it is not a more efficient one, because of its high degree of toxicity above certain amounts. Toxic saturation of the soil moisture can develop very quickly in the decomposition of calcium cyanamide, especially and to a somewhat dangerous though lessened degree with urea and ammonium sulphate as well as with decomposing manure.

Most farmers are familiar with the value of lessening the loss of ammonia emanation in manure piles with the addition of acid phosphate. Addition of acid phosphate to decomposing manure

TABLE I.—ACTUAL AND SLIDING AVERAGE APPLE YIELDS IN POUNDS OF FRUIT PER TREE

Year	Computed Sliding Average[1]		
	N*	Check*	NPK*
SERIES I—STAYMAN			
1918	2	1	19
1919	33	17	41
1920	118	50	147
1921	179	79	184
1922	264	154	250
1923	266	154	232
1924	385	175	344
1925	391	198	388
1926	508	286	551
1927	481	256	578
1928	709	370	830
1929	573	343	710
1930	643	419	763
1931	581	380	704
1932	678	427	783
1933	441	356	546
1934	817	663	1017
1935	675	325	750
1936	587	450	700
1937	1000	308	1100
SERIES II—YORK IMPERIAL			
1918	2	25	91
1919	21	46	95
1920	152	178	201
1921	152	178	201
1922	220	286	285
1923	219	262	203
1924	296	290	309
1925	400	333	374
1926	489	362	479
1927	629	404	481
1928	666	433	704
1929	727	489	642
1930	511	350	651
1931	527	400	682
1932	356	286	767
1933	441	354	578
1934	94	158	900
1935	300	300	670
1936	450	375	600
1937	600	500	750

* N = Nitrogen; P = Phosphorus; K = Potash; Check = Unfertilized.

[1] This overcomes the biennial differences due to on and off year production showing the trend over the entire period.

piles has been found to produce one of the most effective fertilizers. A very beneficial interaction develops as a result of the ammoniation of phosphorus when acid phosphate is mixed with decomposing manure. A similar interaction is allowed to develop with mixtures of calcium cyanamide, urea, and to some extent with mixtures of ammonium sulphate with acid phosphate.

Recent investigations show more clearly the interactions that occur in mixtures of ammonia-producing fertilizers with acid phosphate and potash materials.

Such materials are conducive to higher growth and yield responses in the apple trees. The apple trees will also be benefited by the enhanced growth of any ground cover or cover crops supplied with such materials. When ammoniation also includes potassic materials these responses are the more marked. In view of the superior results that have been secured, fruit growers should find it to their advantage to be aware of some of the beneficial interactions that may take place in adding phosphatic and potassic fertilizers to their nitrogenous materials. This is particularly so in mixtures with calcium cyanamide. It has been found that applications of such mixtures can be made over a much more extended season even through the bud swell of the apple trees up to the green tip stage.

Adequate Organic Matter

Even though the orchard soils in Virginia seem to have an abundance of nitrogenous, phosphatic, and potassic materials without the need of applying them for profit for a period of some hundred years, such is clearly not the case when handling cover crops to secure larger amounts of organic matter in such soils as will be shown directly.

For providing the moisture needs of apple trees, there is no factor so important as adequate organic matter in the soil unless perhaps water can be provided directly in the form of irrigation. Since conditions generally in Virginia apple orchards do not lend themselves profitably to irrigation, the best bet seems to be in the soil retention and conservation of moisture. This, as all orchardists know so well, can best be done only with the highest possible soil-humus content. Just how much organic matter should be incorporated in an orchard soil for the most profitable returns is not easily ascertained.

A partial solution to this as a problem may be offered in determining the weight say of an acre inch of organic matter converted into a soil state to be adequately utilized by the apple trees. It should be explained that no organic matter, even as a mulch, is in an optimum state for utilization by apple trees until it is entirely converted into soil. Such a soil an inch deep weighs 1,000,000 pounds to the acre. In other words, it takes 1,000,000 pounds of organic matter to produce an inch of soil that can provide the optimum conditions of utilization for apple trees and at the same time have the highest possible degree of soil moisture retention. To produce this amount of soil would require 500 tons of organic matter such as timothy hay, millet, or small grain straw. To what extent it would be profitable for a Virginia orchardist to supply his apple orchard with this much organic material is up to him to decide. At least one fact is very clear, higher responses in the growth and production of organic materials have been brought about with the use of phosphatic and potassic as well as nitrogenous fertilizers for more soil fibre.

Such experiments as those of Evans in Ohio with the fertilization of timothy meadows show a production of 3,731 pounds of air dry hay for 120 pounds of nitrate of soda, 240 pounds of 16 per cent acid phosphate, and 80 pounds of muriate of potash to an acre. On adjoining plats receiving no phosphorus or potash but 120 pounds of sodium nitrate, the yield was 3,180 pounds of hay; and for a 5-ton application of farm manure, 3,264 pounds. The superiority of the complete ferti-

lizer over only sodium nitrate and over the farm manure is very evident in this experimental set-up. Such general superiority for complete fertilizer applications is also found in the records of the Virginia Agricultural Experiment Station at Blacksburg, Virginia.

Over a 22-year period 1914-1936, the following results have been secured at this Station near Blacksburg, Virginia: 2.14 tons of clover hay per acre with a nitrogen-phosphorus-potash combination as compared to 1.01 tons where only nitrogen was used. Where applications of the complete fertilizer were made, 2.43 tons of grass were harvested as compared to 1.13 tons when only nitrogen was applied. In these experiments 308 pounds of nitrogenous fertilizer were used. The complete fertilizers contained 438 pounds of acid phosphate and 200 pounds of muriate of potash to the 308 pounds of nitrogen.

In order that a conclusive test could be made to reveal the full effects of certain complete fertilizers as compared to using only calcium cyanamide to increase the organic fibre content of orchard soils, an experiment was started in the fall of 1938. A low-lying plot that had been in pasture for the past 25 years was thoroughly worked up. This was divided into 15 5x15-foot plots of five different treatments in triplicate but in varied order as shown in table II. The fertilizer applications were made on October 13, 1938. All

TABLE II.—AVERAGE TOTAL SHOOT LENGTH OF 30 BEST DEVELOPED RYE PLANTS IN INCHES

Kind of Fertilizer Application

Plots 1, 10 and 14 10–0–0 fertilizer Calcium Cyanamide	Plots 2, 6 and 15 10–6–4 fertilizer Calcium Cyanamide Acid Phosphate and Potash	Plots 3, 7 and 11 10–6–4 fertilizer Sodium Nitrate Uramon, Phosphate Ammonia, Acid Phosphate and Potash	Plots 4, 8 and 12 10–10–5 fertilizer Calcium Cyanamide, Ammonium Phosphate, Acid Phosphate and Potash	Plots 5, 9 and 13 No fertilizer treatment	Difference considered necessary for mathematical significance
Measured April 28, 1939					
11.47	106.25	133.73	104.87	24.88	47.50
Measured May 5, 1939					
28.76	200.80	194.09	191.22	48.05	48.98
Measured May 18, 1939					
64.05	264.45	267.40	267.74	74.38	144.13
Total Straw and Grain Weight In Ounces—Harvested June 19, 1939 (Dry Weight)					
438.5	1013.5	1091.0	1423.5	541.0	151.0
Total Straw and Grain Weight—Harvested June 19, 1939 (Dry Weight) on Acre Basis of Yield—Pounds					
1644	4551	4091	5337	2030	504

plots except the control plots (5, 9, and 13) received the equivalent amount of nitrogen in the fertilizer application. The rye was sown November 12, 1938, about a month after the fertilizers were applied.

The first set of measurements was made on April 28, 1939. Later measurements were taken on May 5 and 18, 1939. See table II. For this purpose 30 of the best developed plants in each plot or 90 for the triplicate group were selected at random down each plot row. The length of every shoot for each plant was taken for its total linear growth. Surprisingly reliable indices were secured by this method of sampling, particularly in the consistency as shown in the final measurement of the total dry grain and straw weight for each plot.

The longest average shoot length per plant occurs finally where a 10-10-5 complete fertilizer was used at the rate of 1,000 pounds per acre. This shoot measurement is consistent with the final total dry weight grain and straw measurements. The total grain and straw weight harvested on June 19, 1939, and then thoroughly dried showed the following yield as calculated on the acre basis: 5,337 pounds for the 10-10-5 plots; 4,551 pounds for the 10-6-4 plots, nitrogen from cyanamide; 4,091 pounds for the 10-6-4 plots, nitrogen from several sources; 2,030 pounds for no fertilizer plots; and 1,644 pounds for plots receiving cyanamide only. With a difference of 504 pounds necessary for mathematical significance, the 10-10-5 plots produced an overwhelmingly significant gain over the no fertilizer plots, with a difference of 3,307 or over 1½ tons in favor of this fertilizer mixture. The most outstanding revelation in this experiment is that the gain for the 10-10-5 fertilizer is close to 1½ times the control plot group or nearly 150 per cent.

The more favorable responses of grasses and other humus-forming crops to complete fertilizers are now clearly evident from the foregoing as well as from results over the greater parts of our nation and in other countries. Inasmuch as a higher organic content in the orchard soil than generally prevails is of great concern to the apple orchardist of Virginia, the intelligent application of fertilizers to such crops should be of still greater concern. Under some conditions it has been found profitable to use as high as 600 pounds and in some even 1,000 pounds of some complete fertilizer like a 10-10-5 or 10-6-4 mixture. Under Virginia conditions such applications paid for themselves in one season's crop. Not only did such applications improve the cover crop growth and the soil moisture holding capacity but increased the fruit yields five times over that where only nitrogen was used.

Three Typical Effects

Kraus and Kraybill point to three typical effects measured principally in terms of total nitrogen, carbohydrate, and moisture as influencing fruit bud formation. These are as follows:

"1. Plants grown with an abundant supply of available nitrogen and the opportunity for carbohydrate synthesis are vigorously vegetative and unfruitful. Such plants are high in moisture, total nitrogen, nitrate nitrogen, and low in total dry matter, free reducing substances, sucrose, and polysaccharides.

"2. Plants grown with an abundant supply of nitrogen and then transferred and grown with a moderate supply of available nitrogen are less vegetative but fruitful. As compared with the vegetative plants, they are lower in moisture, total nitrogen, and nitrate nitrogen, and higher in total dry matter, free reducing substances, sucrose, and polysaccharides.

"3. Plants grown with an abundant supply of nitrogen and then transferred and grown with a very low supply of available nitrogen are very weakly vegetative and unfruitful. As compared with the vegetative plants, they are much lower in moisture and total nitrogen and are lacking in nitrate nitrogen; they are much higher in total dry matter, free reducing substances, sucrose, and polysaccharides."

In the discussion to follow, consideration is given to the concern that many correspondents have recently displayed in the situation that might promote too much of vegetative and too little of fruit bud development. Such concern is very justifiable in the face of the principle that has been correctly worked out physiologically, namely, that an abundance of moisture and nitrogen makes for greater vegetativeness and less fruit bud development. This concern is still more justifiable in the effort of fruit growers to get maximum responses with nitrogen fertilizer applications and full soil moisture conservation, but particularly in regard to the latter over the period from June to September.

Some of the concern over too much moisture may be indicated in the statement made by Magness in his address before the 42nd annual meeting of the Virginia State Horticultural Society, December 9, 1937. He is quoted as follows:

"Conditions last June and July over most of the apple territory were only moderately favorable for fruit bud formation. Our studies during the past 10 years have indicated clearly that we get a higher proportion of fruit bud formation when many bright clear days occur during the months of June and early July, and when soil moisture at that period of the growing season is not too abundant. In 1937, at Washington, D. C., there was a considerable amount of rain and many cloudy days during June and early July. I believe similar conditions prevailed generally over most of this section. Consequently, conditions were not too favorable for fruit bud formation."

Some of the statements made by Magness verify several biometrical analyses made by the writer when he first came to this station 12 years ago. Although the writer agrees with Magness and has found mathematically significant responses in favor of fruit bud formation with the higher proportion of clear sunny days, it was found that there was not enough difference from the practical standpoint to cause any serious inhibition of fruit bud formation due to the higher degree of soil moisture in properly fertilized orchard soils. The only exceptions, and these are rare, were found perhaps in some occasional mountain cove orchard. On the other hand it has been found that the best crop of fruit buds were induced during seasons of above average moisture with well-fertilized soils. If anything, it appears that the orchardist should be more concerned about the best means of soil moisture conservation, even in years of above average moisture, especially in well-fertilized soils.

Fig. IV.—A soft wood peach cleft graft made May 10, 1937 of a 4-month-old greenhouse-grown seedling. This exposure was made on Sept. 10, 1937, after continuous uninterrupted growth and showed at the end of that time several hundred fruit buds which wintered over and came into blossom the spring of 1938. This grafted tree was liberally fed with complete fertilizer and was supplied with abundant moisture. See growth and yield in 1939, Fig. V.

Evidence gathered from observations made by the writer for the past 12 years shows conclusively that the chances for fruit bud development are far better when there is an above-average amount of rainfall along with its conservation as soil moisture, from as early as June

to as late as September. Some of our best crop years during this 12-year period were found in such seasons of more than average moisture. In no case has there been a depressing effect due to an overabundance of rainfall.

In the spring of 1938, Virginia had one of the heaviest blooms on record. Even many Yorks that were booked for the off years came into heavy bloom. To be sure, we did not have a bumper crop in 1938, but that was not due to lack of heavy bloom. Other factors developed after the heavy bloom to cut the crop short. From the observations made over these past 12 years, it is safe to conclude that the chances for heavy fruit bud formation are much higher in years of more than average moisture, particularly in well-fertilized soils. During such seasons even the terminal growths will produce as high as 36 fruit buds in the same current season. Terminal York growths of 1937 produced an average of 11 cluster buds besides producing 20 bushels of apples. (See Fig. II and III.) Some of the linear shoots produced as high as 36 fruit cluster buds.

On the average each of the shoot growths produced in 1937 had about a dozen cluster buds the following spring. Under these conditions the old notion of one year for the production of wood and the next for fruit wood is completely exploded. Here we have a good example of current new wood and fruit bud formation on the new wood. Such conditions best prevail during seasons of above-average moisture during the period of June, July, August, and sometimes even September. On the whole the great concern is too little rather than too much moisture for well-fertilized fruit trees. The best conservation of soil moisture is the effective procedure for the best fruit crops year in and year out.

In so far as inhibiting fruit bud formation, what would constitute an overabundance of soil moisture? Certainly the "above-average" moisture of July and August for both 1936 and 1937 in Virginia as well as the greater part of West Virginia and Pennsylvania could not be considered unfavorable. If anything, it should be regarded as highly conducive to such development. Very likely this condition of "above-average" moisture was nearer the optimum needs for fruit trees. This amount of soil moisture very likely brings about the nice balance required by fruit trees to develop a maximum quantity of fruit buds.

Extensive greenhouse experiments carried on by the writer under conditions of almost perfect control as compared to the average Virginia orchard lead him to conclude that fruit bud development can be induced in apple, pear, peach, and plum seedlings in 3 to 4 years sooner, if they are allowed to grow with maximum vigor over the first 10 months. Peach seedlings germinated by the writer in the fall of 1936, allowed to develop into maximum vigorous growth in fertile soil abundantly watered in the greenhouse, then in the following spring transplanted in

Fig. V.—Same as in Fig. IV at different angle of exposure on Aug. 26, 1939. This second-year graft produced more than a bushel of peaches.

fertile, liberally watered soil in test rows outside, so that there was uninterrupted growth for 12 months, produced fruit buds by the end of that period. Soft wood cleft grafts of such seedlings made in spring and kept in a vigorous state of growth produced fruit buds by fall. Such trees produced over a bushel of fruit the next year. (See Figs. IV and V.)

It is the writer's opinion that the relatively greater soil fertility and moisture permit a quicker optimum of balance which is conducive to fruit formation on the higher level. Judging from the orchard observations of 1937 and 1938 and from the greenhouse results, it would appear that the grower has the far better chance of getting a crop of fruit buds under conditions of relatively high moisture and fertility. Under most conditions this can be brought about with an adequate abundance of complete fertilizers, not only for the direct beneficial effects upon the trees, but for the indirect effect through the cover crop that is grown to insure the fullest possible water-holding capacity of the orchard soil.

It has been definitely revealed by experiments conducted in Virginia for more than a quarter of a century, first —that there is present in the average fruit soils of that State enough of a nitrogenous, phosphatic, and potassic content, if it is possible for the root systems to completely utilize these materials, to provide for an annual pull of 20 bushels of fruit per tree for some hundred years. Second—that in spite of these contents, the experiments and the far-reaching observations throughout the State over this long period show conclusively that apple trees respond directly to complete fertilizer treatments as they grow older and the root systems commence to occupy the soil space to which of necessity they are confined. Third—that as soon as these trees reach this condition of root crowding, a certain plan of a "three-in-one" fertilization should be profitable, as far as increased growth and fruit yield responses are concerned.

Finally, in the light of the scientific evidence that is at hand, not only bringing out the direct responses by the fruit trees themselves but especially in the indirect benefits that they will receive through the fertilized cover crops responding directly, orchardists are advised to recognize a complete fertilizer program. This calls for a very intelligent use of some "three-in-one" fertilizer containing nitrogen, phosphorus, and potassium.

Potash Makes Bank Accounts

(*From page* 22)

ners, were recommending such analyses and at these low application rates.

Canners, in many instances, are inviting trouble by not having courage enough to recommend 500 to 1,000 lb. of high analysis potash-phosphate mixtures. Growing tomatoes on any type of soil closely approximates "intensive cultivation" methods, and large amounts of potash and phosphate are needed. Well-manured soils should be selected, for manured soils always contain humus which permits proper drainage, so necessary for healthy tomatoes.

While this report was being written, Willard Jones, a prominent Putnam County sugar beet and tomato producer, came in and reported that he sold 12 tons of tomatoes per acre this year. His is the best soil type in the county. We recommended last spring that he use 500 lb. 0-20-20 per acre, but he used only 250 lb., or 50 lb. potash and phosphate per acre. We quoted him the August Morman results and urged him to use at least 500 lb., preferably 1,000 lb. of 0-20-20 per acre in 1940.

The same results are secured on sugar beets. Mr. Ben Wehri of Kalida, Ohio, grew 10 acres of sugar beets in 1939. He applied 125 lb. of 2-16-8 per acre in the row on all the acreage. But we persuaded him to broadcast 200 lb. of 0-20-20 on 3 of the 10 acres, this in addition to the 2-16-8 in the row. As a result, he harvested 13 tons of beets per acre where the 0-20-20 was applied, and only 10 tons per acre where the 0-20-20 was not used. The 200 lb. of 0-20-20 cost Mr. Wehri $4.76, while the 3 extra tons of beets will bring about $24, leaving Mr. Wehri a profit of over $19 per acre. That's money farming, made possible by adequate applications of nature's plant vitamin, potash. That is why we tell our farmer friends—potash makes bank accounts.

The Soil Salute

(*From page* 5)

schoolhouse located in any modern town of three thousand. Visible evidences of pomp and power were mighty scarce.

Whatever existed of strength and beauty and hope and faith and vision came from inside the hearts and minds of those old founders of ours. What they fought for was the right to keep on dreaming and building, so that future citizens would realize the "substance of things hoped for and the evidence of things not seen." Unlike us, they were neither blinded nor softened by the presence of too much comfort. They stood right at the grub plow and reached for the shotgun.

You may call the roll of the folks in your family who risked their necks rather than put them in a foreign yoke. You won't find many of them who regarded patriotism or democracy lightly, because they paid dearly for retaining it, even if it wasn't stream-lined and air-conditioned. I doubt if they spent much time cowering and worrying over things the way we do either, maybe because they knew nobody could carry off the continent bodily, and that was what they were most interested in. In short, looking at it in all ways, democracy was in debt to them. But the shoe is on the other foot now, and we are in debt to democracy.

Did you ever stop to think where we would be in a material sense, provided some alien invader reduced our vast accumulated wealth and luxury to dust and ashes?

We would find ourselves right back where we began, at least awhile. We would then be able to share the outlook of those who came to this country two hundred years or less ago. Privation, long weary migrations, rude makeshift dwellings, equipment of the meanest, no tools except those fashioned by hand, no future except that earned by sacrifice and toil.

TWO priceless things we would still possess—the same things our ancestors used to build upon—the soil itself and our unconquerable faith in free democracy. Given the strength of the pioneers, these two assets might save us again.

Yet, observe this, presuming such a thing occurred and we outlived and overcame the situation, our generation would then be as great or greater heroes than the pioneers. Why? Just because they knew nothing else but poverty and hardship all their lives, while we would have to readjust ourselves to new environments. It's always tougher to "take it" when you are used to something better.

In going and coming frequently of late among the farm folks who face realities, I have found them determined that this country assume a firm stand in support of the land. They feel that

no amount of armed might would save us from ruin in case the land and the things for which it stands were lost sight of in the mêlee.

In considering some points in a home-made farm defense program, the advice of many of the soil workers I meet will no doubt contribute thereunto. The farm population is a wise and modern one and cannot be misled easily by half-baked substitutes for the real thing. Here are just a few of the declarations which seem to come uppermost in respect to a definite farm program in the face of changing world affairs.

First, they ask that thorough public consideration be given to the part actually taken by the Federal government in progressive, effectual, soil fertility and land protection. Is the present effort balanced and coordinated and reasonably free from lost motion and needless overhead? Can it be taken completely away from partisan strife and clique control? Is it humanely possible to administer such a huge program without creating ruts? Are we statesmen or drifters?

THEY ask me if the conservation program is becoming so perfunctory and official that few rank and file farmers ever take much direct interest in it. In that case, they exclaim, we ought to stir it up a trifle and keep it alive and responsive. Otherwise it will not mean much to us in terms of soil defenses, because it won't be worth battling for under such circumstances. We've got to know and believe in any program to strengthen it.

Second, they are crying aloud for revival of the so-called "chemurgic" ideas of utilizing farm by-products for industry. Maybe it sounds rather "ersatz" and synthetic, but plenty of farm folks think science can find a wider and a safer zone for agricultural expansion than in mere loading of export ships.

Third, they want to broaden and experiment further with the social benefits to be had from distribution of domestic food surplus to families in need. They want the underprivileged to know that those who have plenty in America are willing to share it. But of course they don't want farmers to finance all the charity. It's their hunch that we must cause the citizens of tomorrow to know the strength that lies in an intelligent use of our abundance from the soil, and be ready to defend that soil in a practical way. Hungry ones living in want on the edge of bounty do not make trustworthy defenders of anything. They would be quick riders for the Trojan steeds.

FARMERS who think at all about research say they want closer coordination and less duplication between State and Federal agencies of experimentation. This is no time they say to compete in rivalry between various State institutions to secure isolated funds for secret research, but it is rather a time to pool what mutual wisdom we have in concert and work together for agricultural goals.

Farmers tell me that this is a time to make the better germ plasm of plants and animals more widely accepted and more intelligently applied by routine farmers. Cattle breeders are dismayed by recent figures showing that there are fewer bred-for-production sires in use today than there were fifteen years ago. Some way must be found to bridge that gap between the blood improver and the livestock student on the one hand, and the everyday feeder and milker on the other.

Oh, there are lots more suggestions made, but the country is so full of theories and spasms nowadays that this seems a good place to rest our case for the present. It is enough to end by saying that I have found few farmers frightened by all this terrorism, and most of them are willing to assume any challenge of citizenship—provided the other portion of the population maintains due respect for the land's importance.

EASILY IDENTIFIED

Sentry: "Halt! Who goes there?"
Voice: "American."
Sentry: "Advance and recite the Star-Spangled Banner."
Voice: "I don't know it."
Sentry: "Proceed, American."

Rastus—"I hear you got cut in the fracas last night."
Sambo—"No suh, boss, I jest got my arm cut some."

"I'll tell my wife a thing or two if she scolds me for coming home late."
"That's bad. Tell her one thing and stick to it!"

A young man was sitting on a seaside hotel veranda near a young, pretty widow, with her 4-year-old son. Presently the little fellow ran up to the man.
"What's your name?" the little boy asked.
The reply being given, the next question was: "Is you married?"
"No, I am not."
The child paused a moment, then turned to his mother and said, "What else must I ask him, mummy?"

NO IMPROVEMENT

"Did that course in English help your boy friend any?"
"No, he still ends every sentence with a proposition."

Papa (taking bath)—"Hey, mother, are you sure you put the goldfish back in their bowl?"

She: "Did anyone ever tell you how wonderful you are?"
Gob: "I don't believe they ever did."
She: "Then where'd you get the idea?"

An old maid is a woman who has been good—for nothing.

"I suppose her outrageous conduct has led her to disgrace?"
"Not at all; only led her to the best place on the front page."

HER PENNY'S WORTH

A fat lady stepped on the scales, not knowing they were out of order, and put in a penny. The scales went up to fifty-seven pounds and stopped. A newsboy standing by noticed the situation. "My Gawd!" he cried. "She's hollow!"

Dolly—"Surely you aren't going to let a blonde steal your boy friend away from you?"
Polly—"Never—I'll dye first."

News Item: "A Topeka woman escaped from the police the other night by slipping out of her pajamas. This proved to be a fatal mistake, however, as it made it easy for the police to trail her behind."

A dusky lady went into a drug store and asked for one-cent's worth of insect powder.
"But that isn't enough to wrap up," said the clerk.
"Nemind 'bout wrappin' it up. Jess blow it down ma back, dassall."

FERTILIZER *Films* AVAILABLE

WE ARE NOW PREPARED TO LOAN without charge to agricultural colleges and experiment stations, county agricultural agents, vocational teachers, responsible farm organizations and members of the fertilizer trade, several films bearing on the proper use of fertilizers, particularly potash. *Distribution is being made from our respective branch offices as noted in the listing below, and anyone interested in showing these films should direct their requests to these offices.*

Potash in Southern Agriculture

Covers fertilization and potash deficiency symptoms of cotton, tobacco, and corn in the various States of the South. Depicts experimental work now in progress at several Experiment Stations, also crops in the field, fertilizer placement work, and scenes in a fertilizer factory.

16 mm.—sound, color—running time 20 min.

Projectors will be loaned where necessary.

Write to—American Potash Institute, Inc., Mortgage Guarantee Building, Atlanta, Georgia.

Potash From Soil to Plant

Covers testing soils to determine fertilizer needs, sampling of soils, potash deficiencies on prunes and grapes, also effects of fertilization on Ladino clover.

16 mm.—silent, color—running time 40 min. (on 1600 ft. reel).

Write to—American Potash Institute, Inc., Beans Building, San Jose, California.

Bringing Citrus Quality to Market

Shows influence of fertilizers, particularly potash, on yield and quality of citrus fruit. Quality factors include thickness of rind, volume of juice, weight and general appearance of fruit.

16 mm.—silent, color—running time 25 min. (on 800 ft. reel).

Write to—American Potash Institute, Inc., Beans Building, San Jose, California.

Machine Placement of Fertilizer

Covers methods of applying fertilizer to California orchards, lettuce, and sugar beets. Shows scenes of various types of apparatus devised by growers for applying fertilizer in orchards and on row crops.

16 mm.—silent, color—running time 15 min. (on 400 ft. reel).

Write to—American Potash Institute, Inc., Beans Building, San Jose, California.

New Soils From Old

This film was prepared for the Department of Agronomy, University of Illinois. Deals with the experimental work on Illinois Soil Experiment Fields and stresses the benefits from a balanced soil fertility program using limestone, phosphates, and potash in growing corn, wheat, clover, and other crops.

16 mm.—silent, color—running time 40 min. (on both 400 and 1600 ft. reels).

Write to—American Potash Institute, Inc., Life Building, Lafayette, Indiana. Please indicate size of reels desired.

Fertilizers Improve Midwest Crops

Shows effects of proper fertilization on the growth of corn, wheat, alfalfa, and other crops in Illinois, Indiana, and Iowa. Includes potash, phosphorus, and nitrogen starvation symptoms and their confirmation by chemical tissue tests.

16 mm.—silent, color—running time 40 min. (on both 400 and 1600 ft. reels).

Write to—American Potash Institute, Inc., Life Building, Lafayette, Indiana. Please indicate size of reels desired.

Requests for these films should include information as to group before which they are to be shown, date of exhibition, and period of time of loan.

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